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MASTER PLAN REPORT

SONOMA COUNTY AIRPORT

SANTA ROSA, CALIFORNIA

Arnold Thompson Associates, Inc.
Wilbur Smith & Associates

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MASTER PLAN REPORT

SONOMA COUNTY AIRPORT

[Wilbur Smith + assoc.]
Aviation Airport Sonoma co.

PREPARED FOR

Sonoma County, Calif.

PREPARED BY

Arnold Thompson Associates, Inc.
A subsidiary of Lester B. Knight & Associates, Inc.
&
Wilbur Smith & Associates

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Arnold Thompson Associates, Inc. ☐ Airport Consultants ☐ P. O. Box 8368 ☐ San Francisco International Airport ☐ San Francisco, California 94128 ☐ 415-692-3786
A Subsidiary of Lester B. Knight & Associates, Inc. Chicago, Illinois

October 1975

County Board of Supervisors
Sonoma County, California
Santa Rosa, California 95401

Gentlemen:

Arnold Thompson Associates, Inc., is pleased to submit the Master Plan Report for Sonoma County Airport.

This report represents many months of study, planning, and discussions between members of our firm, the County Planning Department staff, the Director of Aviation and his staff, the Federal Aviation Administration, and the other involved interests. The recommendations set forth are based on studies and analyses conducted by the Consultant together with professional judgment gained from experience in aviation and transportation planning.

We trust that the Master Plan Report meets with your approval and will serve as the guideline for the future development of Sonoma County Airport.

Respectfully submitted,

ARNOLD THOMPSON ASSOCIATES, INC.

October 1975

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I - INTRODUCTION

Arnold Thompson Associates, Inc., in association with Wilbur Smith and Associates, Inc., was commissioned by the County of Sonoma, California, to undertake an airport master planning study for the Sonoma County Airport, Santa Rosa, California. The preparation of this airport master plan report was financially aided through a Federal Grant from the Federal Aviation Administration, an agency of the U.S. Department of Transportation, under the Planning Grant Program authorized by Section 13 of the Airport and Airway Development Act of 1970.

Toward the preparation of this master plan report, the following study elements were involved:

- An inventory and review of existing airport facilities, local and areawide plans and studies, and factors that have and could affect the development of Sonoma County Airport was accomplished. The inventory and review included considerations such as socioeconomic trends in the area, previous airport studies, historical activity at the Airport, land uses on and off the Airport, airspace, relevant local and state laws and ordinances, other airports in the area, airport accessibility, and the financial resources of the Airport.

- Forecasts of aviation activity for the ensuing 5, 10, and 20 years were developed.

- Having determined the levels of activity forecast for the Airport, the capacities of existing facilities were determined.

- Through comparisons of the forecast levels of aviation activity demand and the capability of existing facilities to satisfy that demand, a determination of capacity deficiencies was made, translated into future facilities requirements at the Airport, and alternative plans developed.

- The alternative development programs were evaluated based upon technical, environmental, economic, and social considerations; the optimum solution was selected; and appropriate plans were prepared.

- An investigation was made of land uses in the vicinity of the Airport and their compatibility with existing airport activity and proposed development was evaluated. Recommendations for insuring future land use compatibility were made.

- The development of planned facilities was staged in increments to maintain consistency with growth in demands. Cost estimates for these facilities were developed.

- Based upon forecasts of demand and the planning of facilities, projections of the Airport's financing capabilities were made accompanied by appropriate financing recommendations.

The plans and drawings contained in this report are intended to be illustrative of the functional, circulatory, quantitative, and spatial relation of the elements which were developed from the forecasts, surveys, planning requirements, and operational characteristics of the Airport.

The plans and drawings are not to be considered a complete architectural or engineering solution to the development of Sonoma

County Airport, but these should be the springboard from which an architectural-engineering team can proceed with the development of the detailed plans, specifications, and construction documents for the recommended project.

This airport master plan report for Sonoma County Airport reflects the contributions of many groups and individuals. The Consultant wishes to acknowledge the contributions of Mr. Robert W. Dunn, Aviation Director, Sonoma County Airport; Mr. Robert E. Nicholson, Assistant Planning Director, Sonoma County Planning Department; Mr. Robert L. Becker, Assistant Airport Manager; Mr. James D. Dale, Auditor, Sonoma County Auditor/Controller's Office; and Mr. Les Hopkins and Mr. Skip Erhard, Federal Aviation Administration Airport District Office, San Francisco.

II - CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Studies, analyses, and the resultant findings, with respect to the master planning of Sonoma County Airport, led the Consultant to the following conclusions:

1. Sonoma County Airport, at its present location, is capable of expansion to accommodate the activity levels forecast to occur through the late 1980's.

2. Demand for aircraft operations at Sonoma County Airport are projected to increase from a recorded volume in 1974 of 147,007 annual operations to 380,000 operations in 1985 and 620,000 in 1995.

3. General aviation activity at Santa Rosa Air Center will gradually be transferred to Sonoma County Airport. The closure of any additional airports in the Santa Rosa area would generate demand in excess to that which was projected.

4. The airfield, in its present configuration, is nearing operational capacity. The construction of a parallel runway will provide the optimum expansion reflected in Conclusion 1 above.

5. An additional airport in the Santa Rosa area will be required in order to meet demands of general aviation beyond the late 1980's.

6. The primary role of Sonoma County Airport will be to serve general aviation. However, the thriving Sonoma County-San Francisco commuter air carrier

service is expected to grow and increased demand may result in commuter flights to Los Angeles. Usage of the Airport by nonscheduled air carrier aircraft is expected to increase.

7. The runway length at Sonoma County Airport is adequate to accommodate the aircraft presently using the Airport, as well as those projected to use it in the near future. Frequent scheduling of air carrier operations by jet aircraft, such as the DC-9 and B-737, may require additional runway length. A runway extension affording 6,000 feet of length is currently eligible for Federal Aviation Administration funds.

8. There is space available to accommodate most of the future development on the east side of the Airport. There is additional space on the west side of the airfield for the development of special, aviation-related interests.

9. Public-use areas of the terminal building are becoming very congested during busy periods. The terminal is capable of expansion at its present location.

10. The terminal building parking lot is capable of accommodating airline passenger traffic until the late 1980's, even though it is very inefficient in design.

11. Sonoma County controls an insufficient amount of land in the approaches to Runway 14-32 and Runway 1-19.

12. Most of the land uses in the vicinity of the Airport (with the exception of some scattered residential areas) are compatible with present and projected airport operations.

RECOMMENDATIONS

In order to provide for the orderly development of Sonoma County Airport, it is recommended that:

1. High priority be given to the construction of a general aviation runway parallel to Runway 14-32 and a support taxiway system for the new runway.

2. A pavement strength analysis be conducted at the Airport. If improvements are necessary, the pavement should be strengthened to accommodate DC-9 and B-737 type aircraft although these aircraft are not presently being utilized at the Airport.

3. Runway length requirements at Sonoma County Airport be closely monitored and, if the requirement for additional length arises, a detailed investigation be conducted evaluating the various extension alternatives presented in this report.

4. The apron west of the terminal building be expanded to accommodate the transient parking requirements of large general aviation aircraft.

5. An addition to the north end of the terminal building be constructed in the near future. This addition should be structurally designed to support a second floor which will be required later in the forecast period.

6. A drainage pipe in the ditch between Taxiways A and B be installed by the County. As it becomes available, clean fill should be deposited in this ditch and the area ultimately paved for use as an aircraft parking area.

7. T-hangar development should continue in the area south of the terminal. Should this area not meet the ultimate requirements, ample space is available on the west side of the Airport for continued development.

8. The County should immediately begin a program of acquiring land both north and south of the Airport in order to protect the approaches to Runway 14-32 and Runway 1-19.

9. Current County land use policies and plans affecting the airport environs favor limited development concentrated in the Highway 101 corridor, preservation of agricultural land, and encouragement of airport-related and light industrial uses adjacent to Airport Boulevard. These policies should be continued as they are consistent with the proposed Airport Master Plan and related airport impacts.

10. Open space and agricultural uses should be preserved and encouraged as a natural buffer between the Airport and surrounding development.

III - FACILITY INVENTORY

HISTORY

Sonoma County Airport is located north of San Francisco Bay, approximately 7 miles northwest of the City of Santa Rosa. In 1939, Sonoma County purchased approximately 339 acres for airport purposes in a joint venture with the Civil Aviation Agency (predecessor to the Federal Aviation Administration). The Army Air Corps added 826 acres, completed construction, and took over the Airport in 1943 for use as a military installation.

Between February 1943 and January 1946, the Airport was operated by the U.S. Fourth Air Corps, primarily for fighter training purposes. The number of personnel based at the field was as high as 10,000 during this period.

On July 8, 1946, the County resumed operation of the Airport as a civil facility. In March 1947, Southwest Airways (changed to Pacific Airlines in 1958) operated a DC-3 out of Sonoma County Airport as the first scheduled commercial flight. In later years, this airline operated Martin 202's and 404's and even an occasional Fairchild F-27 at the Airport.

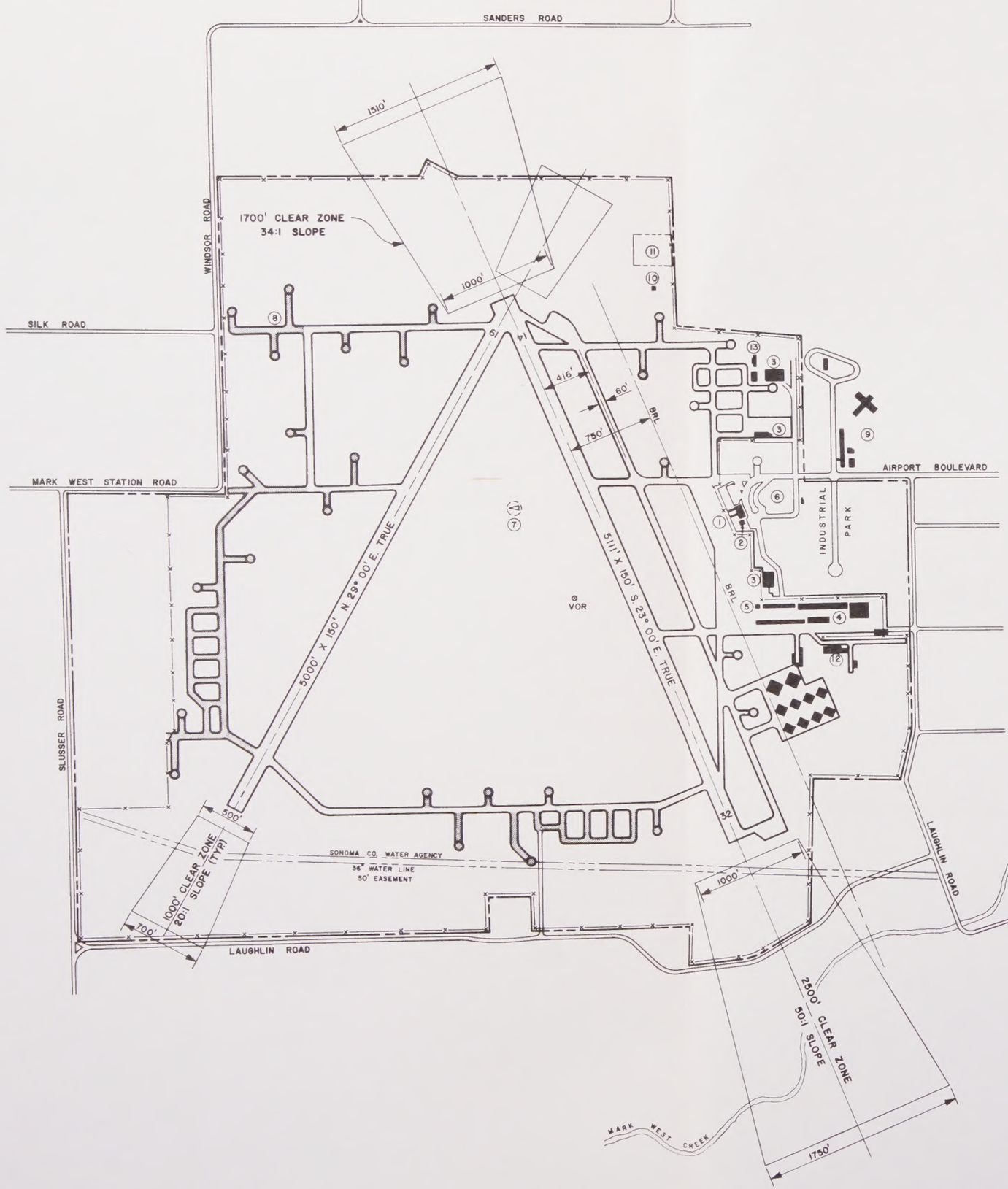
In 1968, Pacific Airlines was merged into Hughes Airwest, which presently serves the County with F-27 aircraft. Scheduled feeder/commuter service by STOL Air, Inc., began in September 1972 with Sonoma County Airport as the base for its activity. In the past, Sonoma County Airport has also had service to various Northern California cities via commuter carriers such as Golden Pacific and Golden West, using Beech 99 aircraft.

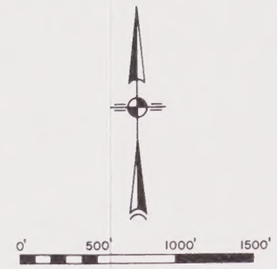
EXISTING FACILITIES AND ON-AIRPORT LAND USE

Drawing 1 graphically describes the existing facilities and the present land uses at the time of this report. The Airport has two runways (Runway 14-32 and Runway 1-19) each 150 feet wide and approximately 5,000 feet in length.

Runway 14-32 is the primary runway and its strength is estimated at 53,000 pounds loading for dual landing gear. The secondary runway (1-19) is estimated at 75,000 pounds dual loading. Both runways have a 3-inch asphaltic concrete surface and an original base of 10 to 12 inches of gravel. It should be emphasized that load ratings are based upon original construction plans and, if more accurate data are required, engineering field studies should be conducted. The Federal Aviation Administration (FAA) classifies the majority of soil in the paved areas as either E6 or E7. These soil types provide a good base for paving since the Airport is well drained and is not subject to frost action.

Runway 14-32, the primary runway, is equipped with high intensity runway lights and marked as a Precision Instrument Runway. Runway 1-19 has basic runway markings and no runway lighting. There is a Very-High-Frequency-Omni-Directional-Range (VOR) Transmitter located on the field which has, until recently, been used for non-precision instrument approaches into the Airport. An Instrument Landing System (ILS) has been installed on Runway 14-32, thus establishing a precision instrument approach at the southern end of the runway. This system consists of a Glide Slope (GS) and Localizer (LOC) Transmitter, Middle Marker (MM), Outer Marker (OM), High-Intensity Runway Lighting (HIRL), and Medium-Intensity Approach Lights with Runway Alignment Indicator Lights (MALSR). At the time of this writing, the approach lights were still being installed with completion expected in 1975. Runway End Identifier Lights (REIL) are installed at both ends of Runway 14-32. When the approach lighting system is completed, the REIL at the south end of Runway 14-32 will be removed.





DRAWING LEGEND

AIRFIELD PAVEMENT	
ABANDONED AIRFIELD PAVEMENT	
BUILDINGS	
PROPERTY LINE	
CLEAR ZONE	
BUILDING RESTRICTION LINE	BRL
FENCE	

BUILDING & FACILITY LEGEND

NO.	ITEM
1	TERMINAL BUILDING
2	AIR TRAFFIC CONTROL TOWER
3	FIXED BASE OPERATOR
4	AIRCRAFT STORAGE HANGARS
5	FIRE, CRASH & RESCUE STATION
6	AUTO PARKING
7	WIND TEE & SEGMENTED CIRCLE
8	EXPERIMENTAL AIRCRAFT ASSOCIATION
9	NON-AVIATION RELATED COUNTY FACILITIES
10	FAA REMOTE TRANSMITTER/RECEIVER
11	SEWAGE TREATMENT FACILITY
12	LIGHT MANUFACTURING
13	FIRE ATTACK FACILITIES

SONOMA COUNTY AIRPORT
SANTA ROSA, CALIFORNIA

EXISTING FACILITIES PLAN

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

1

At the time of its original construction as a military airfield, numerous taxiways and hardstands were constructed; however, the County presently maintains very few of these for aviation use. In addition to the original 50-foot taxiways, the County constructed a taxiway 60 feet wide parallel to Runway 14-32 in order to provide better access to this runway. The taxiway was constructed with a 4-inch asphaltic concrete surface over an 8-inch base giving it a bearing strength of 100,000 pounds dual loading. There are presently no lights for this taxiway.

The passenger terminal building is located at the approximate midpoint of Runway 14-32 and 1,150 feet northeast of the runway. The present building has approximately 5,650 square feet of usable space and a recently constructed apron rated at 100,000 pounds dual loading is capable of accommodating three to four (medium-sized, e.g., DC-9) aircraft.

The Air Traffic Control Tower, operated from 7 a.m. to 11 p.m., is located immediately south of the terminal building. The tower building also serves as the district center for the FAA's Airways Facilities Field Office and houses a flight training ground school.

Also south of the terminal is a large "L" shaped ramp that was constructed by the military and now serves as a tie-down and aircraft storage area. T-hangars and shaded storage for some 68 aircraft are situated on the southern portion of the ramp, and the fixed base operations of Redwood Aviation Enterprises are located adjacent to the ramp. Also, 40 enclosed aircraft storage hangars have been recently constructed south of the T-hangar area. In addition, there are some portable hangars, a few small light manufacturing establishments, and some maintenance buildings in this area.

In the area north of the terminal, there are facilities of two fixed base operators (FBO's) and a Forestry Fire Fighting Station. The Fire Attack Base is owned by the State of California and is a key base in the aerial fighting of forest fires throughout northern California, as well as serving as

a 24-hour fire station. Sis-Q Flying Service (an FBO) is a maintenance and office center primarily furnishing aircraft and crews for the aerial fire fighting efforts. Nation Flight Service (an FBO) located south of Sis-Q provides standard general aviation services to the flying public.

On the northeastern corner of the airport property, the County has a sewage treatment facility, which is expected to accommodate the demand generated by the Airport and a large portion of the area around it. The FAA also has its remote transmitter and receiver located in this same general area.

The land northwest of Runway 1-19 is presently undeveloped with the exception of a small area leased to the Northern California Experimental Aircraft Association and a completed sanitary landfill area east of Slussen Road, which is being used by a Rod and Gun Club. The remainder of the property along the south and southeastern side of the field is undeveloped, although there are immediate plans to construct a series of aircraft storage hangars just south of the present T-hangar area.

There are storage facilities for 25,000 gallons of aviation gasoline and 12,000 gallons of jet fuel on the Airport. Underground storage is available for gasoline in an area just east of Nation Flight Service and beneath the ramp south of the terminal building. Above-ground storage for jet fuel is situated north of Redwood Aviation Enterprises.

AIRSPACE

Sonoma County Airport is the only airport in the County with an FAA Control Tower. Aircraft operating in the airport traffic area, which includes all airspace from the ground up to 3,000 feet within a 5-mile radius of the Airport, must maintain radio contact with the tower.

In addition to the airport traffic area, which applies to all airports with an operating control tower, the FAA has established a control zone with the same horizontal dimensions as the airport traffic area, extending from the ground up to 14,500 feet above Mean Sea Level (MSL). The airspace within this control zone is designated controlled airspace in order to protect aircraft operating under Instrument Flight Rules (IFR). Within this airspace area, pilots flying under Visual Flight Rules (VFR) must maintain specific distances (1,000 feet above, 500 feet below, or 2,000 feet horizontal) from clouds and a minimum of 3 statute miles visibility. The floor of additional controlled airspace over the remainder of Sonoma County, outside of the 5-mile radius, is 1,200 feet Above Ground Level (AGL), with the exception of an area in the south within 23 statute miles of Hamilton Air Force Base, where the floor drops to 700 feet AGL.

It is possible for aircraft to operate within the control zone with minimums less than those previously described if the pilot requests and receives from air traffic control "special VFR clearance". The weather and cloud clearance requirements for special VFR flights are: 1-mile ground visibility if landing or departing; 1-mile flight visibility if transitting the control zone; and flight to be conducted clear of clouds.

Victor Airways are low altitude enroute flight corridors based upon the system of Very-High-Frequency-Omni-Directional-Range (VOR) and Very-High-Frequency-Omni-Directional-Range Tactical Air Navigation (VORTAC) navigational aids, and are used primarily by aircraft on instrument flight plans. There are segments of seven Victor Airways passing over Sonoma County presently; however, none attract such utilization as to appreciably affect operations at the County Airport.

EXISTING ACCESS

Because of the location of the Sonoma County Airport relative to the population of its service area and to the existing street and highway network of the County, nearly all access to the Airport is via Airport Boulevard from the U.S. Highway 101 interchange.

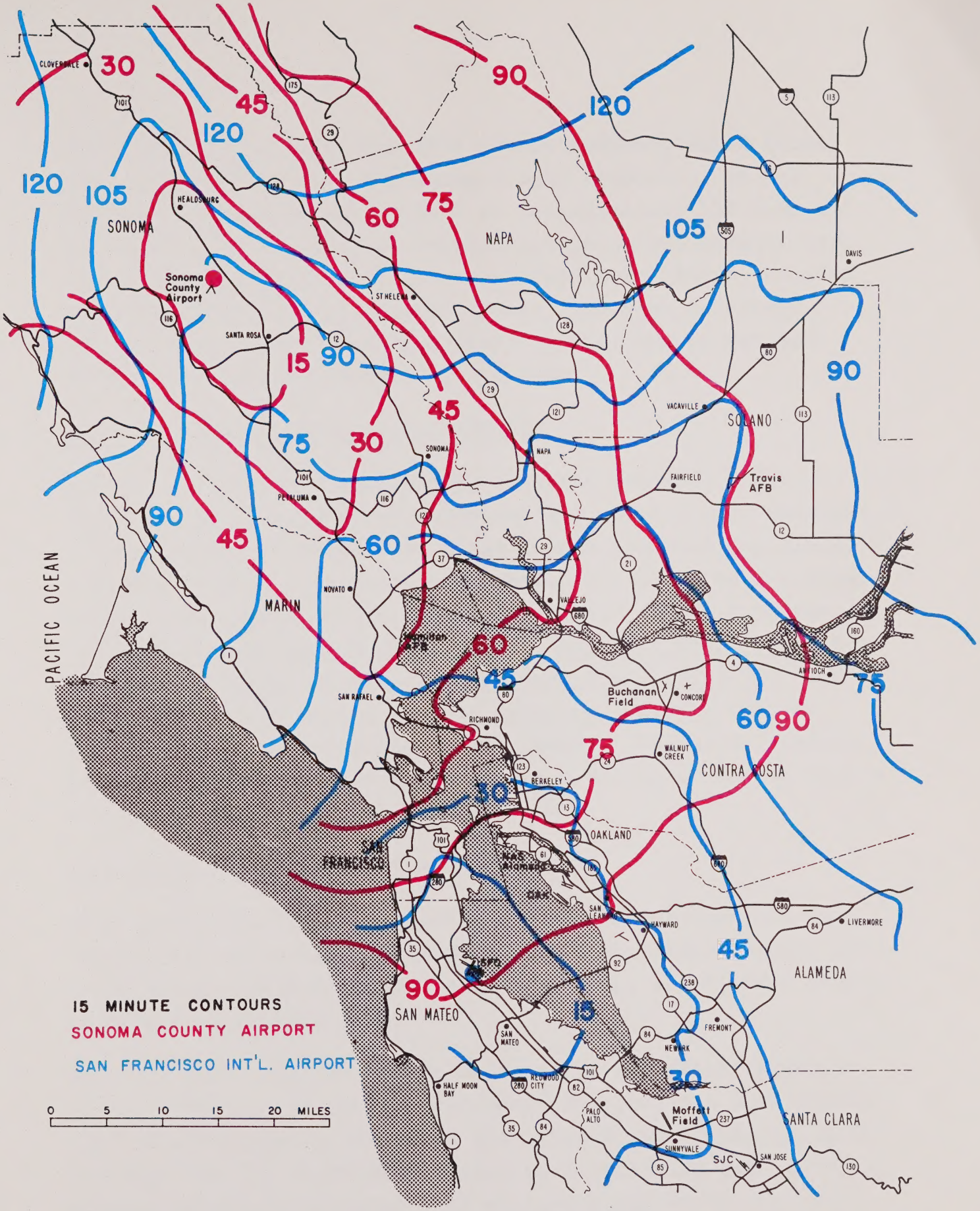
U.S. Highway 101 is the primary route connecting San Francisco with the northern coast of California. For most of its length through Sonoma County, it is a four-lane divided, access controlled highway except for two short sections where it passes through Geyserville and Cloverdale.

Airport Boulevard is a two-lane land service road which runs approximately 3 miles between Old Redwood Highway on the east to its terminus at the Sonoma County Airport. The interchange of Highway 101 and Airport Boulevard is of a half cloverleaf design such that it provides for all turning movements except the westbound Airport Boulevard to southbound Highway 101 and the northbound Highway 101 to eastbound Airport Boulevard.

There are several other minor roads surrounding the Airport: Laughlin Road, Slusser Road, Mark West Station Road, and Windsor Road; however, the volume of airport-related traffic on these roads is negligible.

In evaluating access as it relates to the geographic influence of an airport, average travel time to reach the airport is an important criterion. A major factor in an air traveler's decision to use one airport versus another is the difference in time it will require to reach each alternative.

Average travel times to Sonoma County and to San Francisco International Airport from different points within the Bay Area were studied and are presented graphically in Figure 1. From



TIME TRAVEL CONTOUR COMPARISONS

FIGURE 1

the figure, it can be seen that within southern Marin County the ground travel time to Sonoma County Airport or to San Francisco International Airport is approximately the same (45 minutes). Travel times to Oakland International Airport were also studied; however, it was determined that within the area of prime concern, i.e., Sonoma, Marin, and Napa counties, travel times to San Francisco International and to Oakland International were essentially the same.

REVIEW OF PLANS, STUDIES, AND REPORTS

During the course of this study, existing Federal, State, Regional, and County plans, studies, and reports were reviewed and analyzed with respect to their impact upon the Consultant's planning efforts. Particular attention was given to a review of the Association of Bay Area Governments' (ABAG) reports: Regional Airport System Study (RASS), Bay Area Study of Aviation Requirements (BASAR), and Regional Plan, 1970-1990; and to the California Master Plan of Aviation, Phase I report, Daniel, Mann, Johnson & Mendenhall (DMJM). The major findings of these studies affecting the master planning of Sonoma County Airport are reviewed below.

ABAG Regional Airport System Study (RASS)

This study sets forth objectives and recommendations for the development of an airport systems plan that takes thorough account of all aviation needs, area resources, and diverse public interests in the Bay Area.

The plan calls for the development of San Francisco International Airport, Oakland International Airport, San Jose Municipal Airport, Travis Air Force Base (joint civil/military use), and Hamilton Air Force Base (joint civil/military use) or Napa County Airport as the principal airline airports to serve Bay Area residents. The development of Sonoma County Airport as

a "principal" airline airport was considered in the preliminary airport alternatives (Alternative 3) established by the RASS Committee.

In a special study of the potential for California Corridor airline service to the North Bay counties, the major conclusions of the RASS Committee with respect to the development of Sonoma County Airport as a "principal" airline airport were that, "... Airspace would not be a problem. Capacity could easily accommodate the 1.1 million Corridor passengers projected for 1985." (Corridor passengers are those flying between Southern California, principally Los Angeles, and the Bay Area.) And that, "...the Airport is located some distance from Santa Rosa and limited civil jet operations would not have a major noise impact on existing land uses."

The study found, however, that both Hamilton Air Force Base and Napa County Airport would attract more total Corridor passengers than Sonoma County Airport because of relative access to population centers. The final conclusion of the study identified "... Hamilton as having the best potential in the northern counties for airline service in the Corridor." The report also concluded, with respect to Sonoma County Airport, that "... This airport would uniquely serve the northernmost areas and would offer a limited advantage to Napa and Marin County residents. It is suggested that Corridor service here will depend upon what happens at Napa or Hamilton."

The Metropolitan Transportation Commission has taken an updated version of the RASS report for incorporation into the Regional Transportation Plan (RTP) as the aviation element. In this version of the plan, four airports have been designated as potential North Bay air carrier airports: Hamilton, Napa, Travis, and Sonoma County. No updated traffic allocations have been made.

ABAG Bay Area Study of Aviation Requirements (BASAR)

The BASAR study deals with the forecasting of future aviation demand in the San Francisco Bay Area. An important conclusion drawn by the BASAR study was that the availability of adequate general aviation airport facilities in an area is, in itself, a very strong influence on the number of aircraft owners located in that area and that the aircraft owner, particularly the recreational flyer, is strongly influenced to live (or possibly work) where he has easy access to appropriate airport facilities.

California Master Plan of Aviation, Phase I Report, DMJM & Assoc.

This Phase I report is a summary of the work accomplished on the California Master Plan of Aviation during the nine months preceding April 1973. The work was primarily concerned with the development of air carrier and general aviation models and the forecasting of California's future aviation demands, together with an evaluation of the airport system required to serve future demand.

The Phase I report forecasts that general aviation aircraft in the State will increase from 20,000 in 1970 to 41,500 by 1985 (7.5% per year) and to 70,000 by the year 2000 (4.2% per year). The report also forecasts that 580 of these general aviation aircraft (unconstrained demand) will be owned by Sonoma County residents in 1985 and that 670 aircraft will be based on the County in 1985.

By the year 2000, the unconstrained forecast for Sonoma County is 1,075 aircraft owned by residents and 1,500 aircraft based in the County. Both of these forecasts of based aircraft assume the closure of one to four current privately-owned airports in the County and the construction of two publicly-owned facilities in the County by the year 2000.

The Plan recommends that site selection studies be undertaken to identify specific sites and that these studies include an

investigation of localities where "bounce strips" (practice fields) could be constructed as relievers for the more active general aviation airports.

Major findings of the State study with respect to commercial passenger forecasts for Sonoma County are discussed in Chapter V, Aviation Demand Forecasts.

Other Reports, Studies, and Plans

Other reports, studies, and plans were reviewed and relevant data has been incorporated where applicable.

REVIEW OF LAWS AND ORDINANCES

Existing Sonoma County ordinances relating to zoning and other local, State, and Federal laws, ordinances, and regulations that may substantially affect the master planning of Sonoma County Airport were reviewed. The following documents were included in this review:

- Sonoma County General Land Use Zoning Ordinance.
- California Laws Relating to Aeronautics, 1970, as amended.
- Federal Aviation Regulations, Part 107, Airport Security.
- Federal Aviation Regulations, Part 139, Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft.

FINANCIAL CONSIDERATIONS

A review of airport financial statements, as provided by the County of Sonoma, indicates that historically, for Fiscal Years 1968 through 1972, the Airport has operated at a cash profit. However, when consideration is given to inter-departmental charges and the funding of capital improvements, the Airport has historically operated at a net loss. The

lack of sufficient airport revenues to enable the Airport to operate at a profit is not uncommon to most airports other than the major large air carrier airports.

Capital improvements to the Airport, other than the existing terminal building, have been financed with Federal matching funds and from the County's General Fund, not through the sale of general obligation and/or revenue bonds.

AREA AIRPORTS

There are seven general aviation airports in the vicinity of Sonoma County Airport that have an effect on the operation of the Airport. These airports serve primarily propeller aircraft under 12,500 pounds and several suffer such operational obstructions as power lines, trees, and poles. These factors further establish the importance of Sonoma County Airport as the major airport in the region and the importance of continued prudent planning for its future development.

The seven airports are discussed in narrative below and their relative locations are shown in Drawing 2. The estimated aircraft operations were obtained from the latest FAA, 5010-1 forms available.

Cloverdale Municipal Airport (north of map boundary)

Cloverdale Municipal is located 18 nautical miles northwest of Sonoma County Airport and 3 miles south of the City of Cloverdale. Although the airport is on land owned by Sonoma County, it is operated by the City of Cloverdale.

The airport has one paved runway (14-32), 3,166 feet long and 60 feet wide. Low-intensity lighting is available on the runway from dusk to dawn. The level of activity at the airport is quite low, with approximately 12,000 operations in 1970. Of these, 58% were classified as itinerant and 42% as local.

MYSTERIOUS VALLEY (PVT.)

2675'

101

HEALDSBURG (300')

2468'

4344'

LAKE CO. NAPA CO.

2987'

128

HEALDSBURG

USIBELLI (618')

CALISTOGA (365')

CALISTOGA

ANGWIN (1848')

1940'

FLYING K (145')

2204'

1559'

SONOMA COUNTY (125')

VOR SANTA ROSA

ST. HELENA

SANTA ROSA CODDINGTOWN (ABANDONED) (135')

INGLENOOK RANCH (PVT.)

SANTA ROSA

GRAYWOOD (PVT.)

SEBASTOPOL

SANTA ROSA AIR CENTER (100')

2463

12

101

29

SONOMA

NAPA

PETALUMA SKY RANCH (79')

SONOMA SKY PARK (20')

PETALUMA

SONOMA VALLEY (05')

VORTAC NAPA

NAPA CO. (33')

BODEGA BAY

MARIN CO.

1

VORTAC POINT REYES

GNOSS (01')

NOVATO

VALLEJO

SAN PABLO BAY

HAMILTON AFB (03')

CONTRA COSTA CO.

LAKE BERRYESSA

YOLO CO.

MOSKOWITE (PVT.)

2819'

80

NUT TREE (112')

VACA DIXON (78')

MAINE PRAIRE (40')

VACAVILLE

VACAVILLE (220')

NAPA CO. SOLANO CO.

TRAVIS AFB AERO CLUB (PVT.)

FAIRFIELD

TRAVIS AFB (62')

GARIBALDI (PVT.)

2 1 0 1 2 3 4 5

SCALE IN NAUTICAL MILES

SONOMA COUNTY AIRPORT

SANTA ROSA, CALIFORNIA

AREA AIRPORTS

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

2

There are 12 aircraft based at Cloverdale Municipal; nine single-engine and three multi-engine. Four of these aircraft are owned by a fixed base operator, two are used for business purposes, and six for personal/pleasure purposes. There is one fixed base operator (FBO) on the airport furnishing most major services. T-hangar facilities for seven aircraft, one conventional hangar for the storage of two aircraft, tie-down spaces for 20 aircraft, and underground storage for 4,000 gallons of aviation fuel are located at the airport.

Healdsburg Municipal Airport

Privately-owned Healdsburg Airport is leased by the City of Healdsburg and is located 10 nautical miles northwest of Sonoma County Airport and 3 miles northwest of the City of Healdsburg. There are 28 aircraft based at the airport, most of which are single-engine, personal/pleasure aircraft and, in 1970, annual operations were estimated to be 18,000.

The airport has a single runway (13-31), 2,570 feet long and 50 feet wide. One fixed base operator is located on the airport and a maintenance hangar is available. Some 1,500 gallons of aviation fuel is stored underground and there are 15 T-hangars plus one other building available for aircraft storage.

Sonoma Sky Park

Sonoma Sky Park is located 23 nautical miles southeast of Sonoma County Airport and 3 miles southeast of the City of Sonoma. The continued availability of Sky Park as a public-use aviation facility is uncertain and the effect of its possible closure is discussed further in Chapter V. A 2,500-foot paved runway (7-25), 50-feet wide, with low-intensity lighting is available. The privately-owned airport is attended only during daylight hours with runway lighting to midnight; lighting after midnight is provided upon prior request.

There were approximately 30,000 operations at the airport in 1970, of which 75% were general aviation local. Of the 66 aircraft based at Sky Park, 63 are for personal/pleasure use, 2 for business use, and one belongs to the fixed base operator. The FBO aircraft and one business aircraft are the only multi-engine aircraft based at the airport.

There are 16 T-hangars, a flight school headquarters building, and a 12-foot by 60-foot FBO structure located on the airport. Tie-down space for 35 aircraft is provided and underground storage for 4,000 gallons of aviation fuel is available.

Petaluma Sky Ranch Airport

This privately-owned airport is located 17 nautical miles southeast from Sonoma County Airport and 2 miles northeast from the City of Petaluma. The continued availability of Petaluma Sky Ranch as a public-use aviation facility is also uncertain and the effect of its possible closure is discussed in Chapter V.

One 2,500-foot by 50-foot, asphalt runway (7-25) is available. The airport is attended from 8 a.m. to dusk and medium-intensity lighting is provided on the runway. There were 35,000 estimated general aviation operations at Sky Ranch in 1970; 20,000 local and 15,000 itinerant. These operations were generated by the 60 single-engine aircraft presently based at the airport.

Inside storage is provided for 20 aircraft by 18 T-hangars and 2 other buildings. Maintenance facilities, a flight school, and a coffee shop are located on the airport. Underground aviation fuel storage for 3,000 gallons is available.

Sonoma Valley Airport

Located 24 nautical miles southeast of Sonoma County Airport and 5 miles south of the City of Sonoma, this privately-owned

airport is the base for 67 aircraft. Two turf runways are available: Runway 7-25 is 2,460 feet in length and 100 feet wide (because of flooding, this runway is closed during winter months); Runway 16-34 is 2,900 feet long with a width of 100 feet. No lighting is provided and the airport is attended only during the daylight hours.

In 1970, there were an estimated 50,000 operations at Sonoma Valley with an even split between general aviation local and itinerant operations. There is only one multi-engine aircraft based at the Airport. Aircraft storage facilities consist of T-hangars (20) and 3 other buildings with space for 20 aircraft. Fuel is stored in a 1,000-gallon underground facility plus a 500-gallon above-ground tank.

Gnoss Field Airport

Owned and operated by Marin County, Gnoss Field is located 25 miles southeast of Sonoma County Airport and 3 miles from the City of Novato in Marin County. There are 135 aircraft based at Gnoss Field, including 3 business aircraft operated by professional crews. One runway (13-31), 3,300 feet long and 60 feet wide with medium-intensity lighting is available. Two FBO's provide services at the airport.

Six T-hangars plus two other buildings with storage capability for 16 aircraft and two 10,000-square foot maintenance hangars are located on the airport. Tie-down facilities for 140 aircraft are available. Underground storage for 4,600 gallons of aviation fuel is provided. There were approximately 150,000 operations at Gnoss Field in 1972 with an even distribution between local and itinerant operations.

A master plan study for the airport is presently being conducted and the preliminary findings indicate that the airport will not be developed beyond general utility standards (medium-

size, twin-engine general aviation aircraft not exceeding 12,500 pounds).

Santa Rosa Air Center

Previously a U.S. Navy base, the Air Center is located approximately 6 nautical miles south of Sonoma County Airport and 3 miles southwest of the City of Santa Rosa. There are 90 aircraft based at the Air Center; 77 are for personal/pleasure use, 7 for business use, and 6 are owned by the fixed base operator. Seven of the aircraft are multi-engine, which includes one turboprop aircraft. Approximately 48,000 operations were performed at the Air Center in 1970 with an even split between local and itinerant general aviation flying.

A 7,000-foot by 200-foot, concrete block runway (16-34) is provided. No lighting is available and the airport is unattended. There are no T-hangars at the airport; however, storage for 12 aircraft is provided in three other buildings. Fuel is provided in two 1,000-gallon tanks stored underground.

Calistoga Airpark

Located in Napa County, this privately-owned facility is approximately 12 nautical miles northeast of Sonoma County Airport and within the City of Calistoga. One 2,600-foot runway (10-28), 12 feet wide, with an asphalt surface is available. Eleven of the 19 aircraft based at Calistoga are engineless sailplanes; no multi-engine aircraft are based at the airport.

One T-hangar and one wood frame structure with storage for two aircraft are located on the airport.

Other Area Airports

In addition to the airports discussed above, there are five small, privately-owned airports in Sonoma County. These are: Potterton, near Annapolis; Sea Ranch, near Gualala; Mazza, near Petaluma; Flying K Ranch, near Windsor; and Tri-County Copters, near Monte Rio. Altogether, there are seven aircraft, including two helicopters, based at these airports. Only one, Sea Ranch, has a paved runway. Tri-County Copters is a heliport only. Because of their minimal scope of services and limited facilities, none of these airports are expected to have any influence on operations at Sonoma County Airport.

IV - AIR TRADE ANALYSIS/HISTORICAL AVIATION ACTIVITY

AIR TRADE AREA

The area served by an airport is designated as the air trade area. It is important to determine the boundaries of an air trade area because the level of activity at an airport depends upon the socioeconomic characteristics of its air trade area and the proximity of other airports offering comparable service. For purposes of statistical analysis, an air trade area is selected so as to coincide with political boundaries. The Consultant recognizes that the area served by an airport does not always precisely coincide with political boundaries; however, experience has shown the discrepancies to be insignificant.

An analysis of activity at Sonoma County Airport has shown that the Airport has two air trade areas: one for general aviation activity and one for scheduled passenger and cargo traffic.

General Aviation Air Trade Area

An analysis of the County Assessor's records and the results of an independent survey of airport users performed by Sonoma County and designed and tabulated by the Consultant indicate that general aviation activity at Sonoma County Airport is for the most part generated by residents of the City of Santa Rosa and vicinity (which includes Healdsburg, Sebastopol, and Guerneville). This is probably the result of a total of 10 other general aviation airports available in the County.

Results of the independent survey and tabulations of the County Assessor's data appear in the Historical Aviation Activity section of this chapter.

Figure 2 illustrates the General Aviation Air Trade Area; the Census Tracts included within this area are Numbers 1514 through

LEGEND

GENERAL AVIATION AIR TRADE AREA

GENERAL AVIATION AIR TRADE AREA

FIGURE 2

1540, exclusive of Number 1535. Some 84% of the aircraft owners who base their aircraft at Sonoma County Airport reside in this area (some 94% of individually owned based aircraft). The results of the independent survey conducted by Sonoma County indicate that over 90% of the users of fixed base operator or private aircraft also reside in this region.

Scheduled Air Carrier Air Trade Area

The only scheduled airline activity in Sonoma County is at Sonoma County Airport, approximately 7 miles northwest of the City of Santa Rosa. Sonoma County Airport is currently served by one scheduled CAB certificated airline, Hughes Airwest, Inc., and by one scheduled third-level feeder/commuter airline, STOL Air, Inc. STOL Air is certificated by the California Public Utilities Commission (PUC).

A scheduled CAB certificated airline is one that is certificated by the Civil Aeronautics Board (a federally appointed regulation body) to provide scheduled service to and from cities specified in the certificate. These services may be either intrastate or interstate in nature, depending on the certificate. A third-level feeder/commuter air carrier is a non-CAB certificated airline operating small aircraft on a scheduled basis between two or more points. Feeder/commuter air carriers generally are intrastate in nature and usually operate under the authority of a state governmental body, such as the California Public Utilities Commission.

Scheduled air trade at Sonoma County Airport is primarily generated from within Sonoma County itself. Some scheduled airline passengers travel to and from the adjacent counties of Mendocino, Lake, Napa, and Marin. However, traffic from these counties is of an insignificant level to include these counties in the primary air trade area for Sonoma County Airport; although the Airport does provide the most convenient service to a large

portion of Lake and Mendocino County residents. It is felt that the reasons residents of these counties are not using the Airport more are the lack of alternative destinations and frequency of service.

The analysis of the independent survey conducted by Sonoma County of airport users supports this conclusion. Over 95% of enplaning and deplaning passengers were from Sonoma County. For this reason, the Primary Air Trade Area for Sonoma County Airport's scheduled air service has been defined as Sonoma County.

SOCIOECONOMIC ANALYSIS

There are several socioeconomic factors that exert varying degrees of influence on the demand for air transportation services and facilities. Some of the more important factors are population, income distribution, employment, and the level of industrial development within the area served by an airport. Accordingly, the emphasis of this analysis was placed upon the characteristics of these factors and their relationships to the demand for airport services and facilities. This analysis should not, however, be considered as an in-depth economic analysis of the Air Trade Area.

Population

Historical population data and population projections for Sonoma County are presented in Table 1. For comparative purposes, the State of California and U.S. statistics are also included in this table. The population projections for Sonoma County and the State of California are based on the State Department of Finance projections and are consistent with the projections used in the Association of Bay Area Governments' Regional Airports System Study (RASS). Total United States estimates are from the U.S. Department of Commerce, Bureau of the Census, Series III-C projections. A comparison of the annual rate of

Table 1

POPULATION GROWTH AND PROJECTIONS
SONOMA COUNTY, STATE OF CALIFORNIA, AND UNITED STATES

Year	Sonoma County	% Change	California	% Change	United States	% Change
1940	69,052	--	6,907,000	--	132,165,000	--
1950	103,405	49.8%	10,643,000	54.1%	151,326,000	14.5%
1960	147,375	42.5%	15,863,000	49.1%	179,323,000	18.5%
1970	204,885	39.0%	20,265,000	27.8%	203,212,000	13.4%
1975[1/]	234,900	14.7%	21,217,000	4.7%	217,640,000[3/]	7.1%
1980[1/]	274,600	17.0%	23,249,000	9.6%	232,966,000[2/]	7.1%
1985[1/]	319,500	16.2%	25,595,000	10.1%	250,205,000[3/]	7.4%
1990[1/]	370,000	15.8%	27,888,000	9.0%	268,883,000[2/]	7.4%
1995[1/]	426,200	15.2%	30,051,000	7.8%	N.A.	--

Notes: 1/ State Department of Finance projections.
2/ Series IIIC projections, U.S. Census.
3/ Interpolation of U.S. Census projections.

Source: U.S. Department of Commerce, Bureau of the Census, and California State Department of Finance.

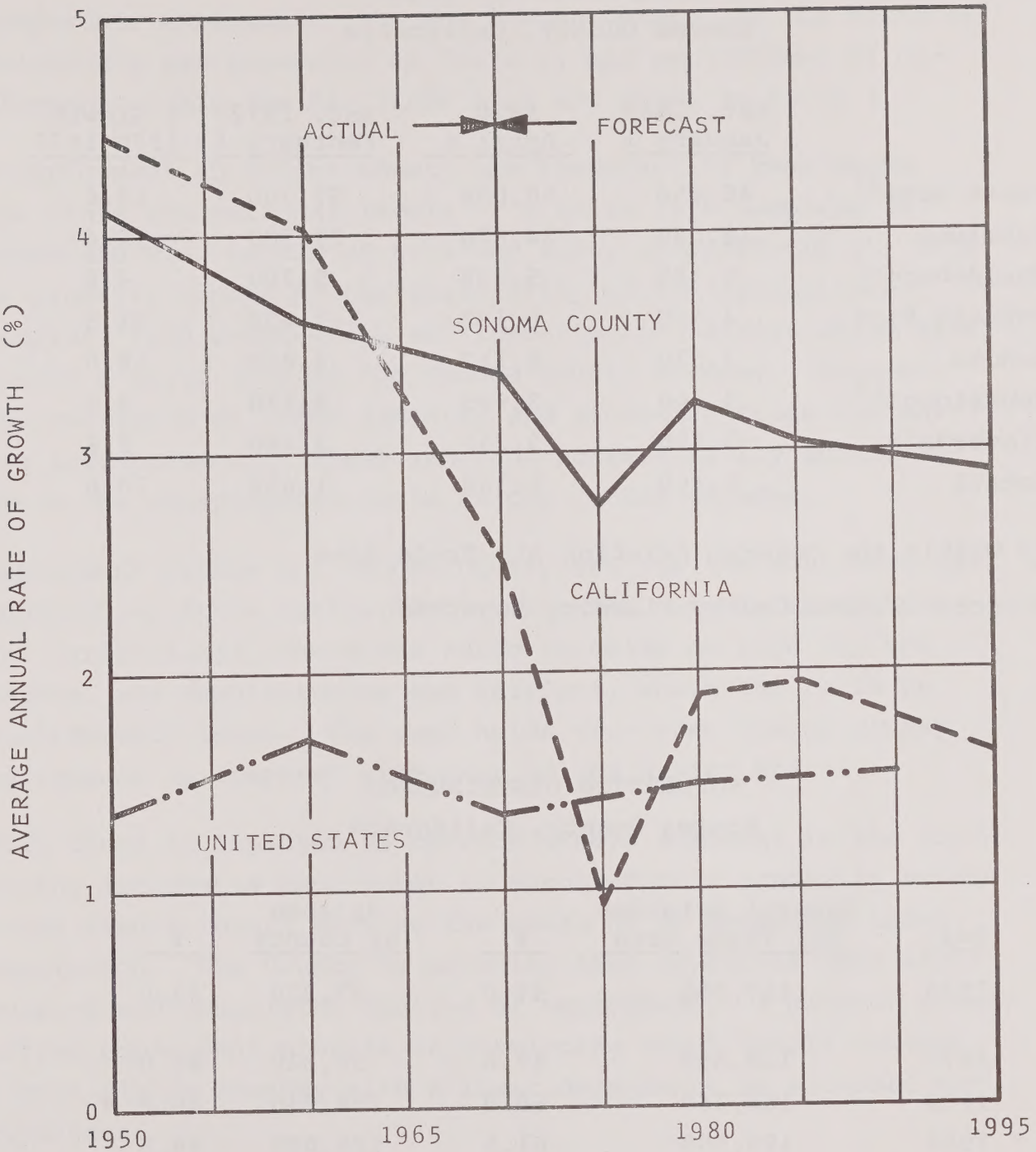
change of population for the U.S., California, and Sonoma County is presented in Figure 3.

Sonoma County's population growth in the decades from 1940 to 1960 lagged behind the State level but was still considerably above the national growth level. However, between 1960 and 1970, Sonoma County population increased by 39% as compared to the State growth of 27.8%. National growth in population was 13.4% for the same decade.

It should be noted that although Sonoma County growth was greater than that experienced by the State as a whole for the 1960-1970 period, the percentage change in population was less than that recorded in previous decades. This trend is expected to continue throughout the study period. That is, Sonoma County percentage growth in population between 1970 and 1995 will exceed that of the State and U.S., but the rate of growth will be lower than in previous decades. The Sonoma County growth for the next two decades should exceed 34%, and population will reach 235,000 by 1975, 320,000 by 1985, and exceed 426,000 by 1995.

Some 57% of total County population resided in the General Aviation Air Trade Area in 1970. Based on 1972 relative growth rates in incorporated areas outside of this region and the Sonoma County policy of effective planning for open space and land use in the unincorporated areas, it is felt that the percentage of total County population residing in the General Aviation Air Trade Area will increase in the future.

Table 2 presents the relative growth of major cities within the General Aviation Air Trade Area and those in the balance of the County. The projected distribution of population in this area and the rest of the County for the study period is also presented in Table 2.



POPULATION ANNUAL RATE OF GROWTH

FIGURE 3

Table 2

POPULATION OF CITIES

Sonoma County, California

	Est. 1965 January 1	1970 April 1	Est. 1972 February 1	% Growth 1970-1972
Santa Rosa[1/]	40,050	50,006	57,300	14.6
Petaluma	18,060	24,870	29,500	18.6
Healdsburg[1/]	5,320	5,438	5,700	4.8
Rohnert Park	4,450	6,133	7,450	21.5
Sonoma	3,570	4,112	4,850	18.0
Sebastopol[1/]	3,540	3,993	4,140	3.7
Cloverdale	3,150	3,251	3,440	5.8
Cotati	1,460	1,368	1,650	20.6

1/ Within the General Aviation Air Trade Area

Source: Sonoma County Planning Department

POPULATION DISTRIBUTION

Sonoma County, California

Year	General Aviation Air Trade Area	%	Balance of County	%
1970	117,555	57.0	87,330	43.0
1975	138,590	59.0	96,310	41.0
1980	164,760	60.0	109,840	40.0
1985	196,500	61.5	123,000	38.5
1990	233,100	63.0	136,900	37.0
1995	277,030	65.0	149,170	35.0

Source: U.S. Department of Commerce, Bureau of the Census, 1970
State Department of Finance projections

Employment

Comparable employment data for Sonoma County and the State of California are presented in Table 3, and projections of employment within the Air Trade Area are shown in Table 4.

Unemployment in Sonoma County has historically been above the State and national levels -- 8.1% in 1970 compared to State and U.S. levels of 6.1% and 4.9%, respectively.[1/] This is probably caused by the seasonality of the agricultural, tourist, food processing, and lumbering industries which have played a major role in the Sonoma County economy. However, the emergence of light industry and expanding trade and service industries with their inherent nonseasonality should improve the unemployment ratio in the future decades.

Employment ratios for Sonoma County are for the most part now approaching State ratios (Table 3). The notable exceptions are Agricultural, where the ratio is twice as high for the County, and Manufacturing and Services, where the ratio is considerably lower. The same holds true when Sonoma County employment is compared with that of the United States.

This trend is expected to correct itself somewhat in the forthcoming decades as employment in Sonoma County gradually orientates itself toward serving the needs of an expanding urban population. The County is becoming less dependent upon agriculture and associated sources of employment. A greater diversified employment profile is developing which should produce a more stable economy with a lower dependence on seasonal occupations.

1/ United States Department of Labor

Table 3

EMPLOYMENT AND UNEMPLOYMENT
SONOMA COUNTY AND STATE OF CALIFORNIA
Annual Averages - 1966 and 1971
(In Thousands)

	SONOMA COUNTY				CALIFORNIA			
	1966	% of Total	1971	% of Total	1966	% of Total	1971	% of Total
CIVILIAN LABOR FORCE	63.3	--	74.2	--	7,591.6	--	8,606.2	--
UNEMPLOYMENT	5.1	--	6.2	--	375.0	--	599.0	--
Unemployment Rate	8.1	--	8.4	--	4.9	--	7.0	--
TOTAL CIVILIAN EMPLOYMENT	58.2	100.0	68.0	100.0	7,216.6	100.0	8,007.2	100.0
Nonagricultural wage and salary workers	42.2	72.5	52.2	76.8	6,145.2	85.2	6,918.6	86.4
Mineral extraction	0.2	0.3	0.3	0.4	32.3	0.5	30.4	0.4
Construction	2.4	4.1	2.6	3.8	305.6	4.2	301.5	3.8
Manufacturing	6.4	11.0	6.9	10.2	1,531.3	21.2	1,472.3	18.4
Nondurable goods	2.8	4.8	2.6	3.8	480.3	6.7	507.5	6.3
Food and kindred products	2.1	3.6	1.8	2.7	171.5	2.4	165.8	2.1
Canning and preserving	1.0	1.7	0.7	1.0	56.7	0.8	56.9	0.7
Other food and kindred products	1.1	1.9	1.1	1.6	114.8	1.6	108.9	1.4
Other nondurable goods	0.7	1.2	0.8	1.2	308.8	4.3	341.7	4.3
Durable goods	3.6	6.2	4.3	6.3	1,051.0	14.6	964.8	12.1
Lumber and wood products	1.9	3.3	2.1	3.1	50.5	0.7	50.4	0.6
Primary and fabricated metals	0.5	0.9	0.3	0.4	166.6	2.3	160.5	2.0
Machinery, electrical equipment, and instruments	0.8	1.4	1.0	1.5	373.5	5.2	374.7	4.7
Other durable goods	0.4	0.7	0.9	1.3	460.4	6.4	379.2	4.7
Transportation and utilities	2.6	4.5	2.8	4.1	410.3	5.7	453.4	5.7
Transportation	1.1	1.9	1.1	1.6	232.5	3.2	250.6	3.1
Communication; electric, gas, and sanitary services	1.5	2.6	1.7	2.5	177.8	2.5	202.8	2.5
Trade	10.5	18.0	13.0	19.1	1,329.3	18.4	1,549.3	19.4
Wholesale	1.6	2.8	2.2	3.2	345.3	4.8	386.2	4.8
Retail	8.9	15.2	10.8	15.9	983.9	13.6	1,935.5	24.2
Finance, insurance, and real estate	3.3	5.7	3.2	4.7	310.6	4.3	385.5	4.8
Finance	1.1	1.9	1.3	1.9	141.8	2.0	180.0	2.3
Insurance and real estate	2.2	3.8	1.9	2.8	168.8	2.3	205.5	2.6
Services	6.8	11.7	9.5	14.0	1,029.1	14.3	1,278.2	18.5
Government	10.0	17.2	13.9	20.4	1,196.7	16.6	1,447.6	20.9
Federal	0.6	1.0	0.7	1.0	306.2	4.2	319.0	4.6
State and Local	9.4	16.2	13.2	19.4	890.5	12.3	1,128.6	16.3
Other nonagricultural employment	10.1	17.4	10.8	15.9	769.3	10.7	801.9	10.0
Agriculture	5.9	10.1	5.0	7.4	302.1	4.2	287.1	3.6

Source: Office of the Department of Human Resources Development.

Table 4

EMPLOYMENT PROJECTIONS
Sonoma County
1975 - 1995

	1975[1]	1980	1985[3]	1995[3]
TOTAL EMPLOYMENT	78,600	89,500	100,200	121,700
Agricultural	4,700	3,200	3,000	3,000
Mining	300	300	300	300
Construction	3,000[2]	3,000[2]	2,800	2,400
Manufacturing	10,100[2]	14,000[2]	16,000	19,000
Transportation/ Communications/ Utilities	3,200	3,600	4,000	4,900
Trade	15,300	17,100	19,000	23,400
Finance/Insurance/ Real Estate	3,500	3,700	3,900	4,300
Services	11,100	14,500	18,100	25,600
Government	16,400	18,700	21,200	26,000
Other	11,000	11,400	11,900	12,800

Sources: 1/ Bank of America National Trust and Savings Association, January 1973.

2/ Sonoma County Economic Development Board and Consultant

3/ Projection of previous trends.

Agriculture will continue to provide Sonoma County's primary economic base; however, the industry as a whole will decline in importance. This industry provided 7.4% of total County employment in 1971, down from 10.1% in 1966. This decrease parallels the decline on the State level and is expected to continue throughout the study period. As a percent of total employment, agriculture is expected to stay above State levels.

Manufacturing employment as a whole has been decreasing both as a percent of total employment and in the absolute. However, based on known plans and forecasts of new companies of national note moving into Sonoma County, this trend is expected to reverse itself. Examples of these firms are Hewlett-Packard, with a forecast employment of 2,500 by 1980 and 4,500 by 1988, and Fairchild Camera and Instrument Corporation, with a conservative estimate of 500 by 1980. According to the Sonoma County Economic Development Board, over ten new firms have located in Sonoma County since December 1972 and more are expected to do so in the near future. In the judgment of the Sonoma County Economic Development Board, manufacturing employment should be at least 13,500 to 14,500 by 1980, a growth of some 97% over 1970. Beyond 1980, manufacturing employment is expected to continue to grow, but at a decreasing rate.

Government employment represents the largest sector in the Sonoma County employment profile. This sector accounted for 20.4% of total employment in 1971. Although it is expected to continue to expand throughout the study period, it should decrease as a percent of total employment. The public education system, with some 6,300 employees in 1970, makes up the largest portion of local government personnel. State government payrolls are dominated by Sonoma State Hospital and California State College, Sonoma.

The Wholesale/Retail Trade sector is the second largest segment of Sonoma County employment and is expected to continue to grow

in response to the projected increases in population and anticipated higher income levels brought about by a diversification of employment. The Trade level of employment is in line with State-wide percentages.

Service industries employment increased by some 40% between 1966 and 1971 and was the fastest growing sector for the period. However, it is still below the State average as a percent of total employment. It is expected to continue to grow at an accelerated rate as increasing population and income stimulate demand. Transportation, Communications, and Utilities are also expected to be stimulated by these factors, but to a lesser degree.

Employment in the Mining sector is expected to remain somewhat static throughout the study period, with Finance, Insurance, and Real Estate experiencing slight but steady growth.

Because of pressure for housing to meet the demands of a growing populous and planned industrial development, the Construction industry is expected to increase between now and 1980. Beyond that period, it is expected to level off and remain fairly static.

The employment participation rate (i.e., the percentage of the population employed within the County) rose only slightly be-between 1960 and 1970, from 31.5% to 32.5%, while the corresponding rates for the State of California were 37.4% and 40.2% and for the United States, 36.4% and 38.4%.2/

The lower rate for Sonoma County is a result of the current seasonality of employment within the County and the fact that, according to the 1970 U.S. Census, nearly 25% of Sonoma County residents are employed outside the County. Although the commuting trend is not expected to reverse itself in the near

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2/ Ibid.

term, the effect of a broader employment base as projected herein should improve the participation rate in the coming decades.

Using 1970 as a base year, total employment is estimated to increase 34% by 1980, by 12% between 1980 and 1985, and by 21% between 1985 and 1995. These projections approximate the employment totals used by the Association of Bay Area Governments' Regional Airports System Study (RASS) in its final plan except for 1975, as can be seen from the following tabulation:

COMPARISON OF PROJECTIONS

	1975	1980	1985
RASS	76,000	90,000	100,000
Consultant	78,600	89,500	100,200

The major difference lies in the assumption by the Consultant that Manufacturing employment will increase at a fairly rapid rate between now and 1975, mainly due to the influence of the Hewlett-Packard development. The RASS projection was prepared prior to Hewlett-Packard's establishing a plant facility in Santa Rosa. Secondly, the emphasis of the RASS study was directed toward a regional total more than to an individual county total; therefore, a less detailed evaluation was made of each county.

Industry

Earnings by broad industrial sector for Sonoma County are presented in Table 5 for selected years between 1959 and 1970. Total Earnings have increased some 106% between 1959 and 1970, from $231,359,000 to $475,687,000. This is a net increase of over $244 million, of which over $209 million, or 85%, was accounted for by the Finance/Insurance/Real Estate, Government, Trade, and Services sectors. The respective increases for each of these sectors were $21.6 million, $93.0 million, $44.7 million, and $49.9 million.

Table 5

EARNINGS BY BROAD INDUSTRIAL SECTOR
SONOMA COUNTY
(Thousands of Dollars)

	1959	1962	1965	1966	1967	1968	1969	1970
TOTAL	$231,359	$250,539	$325,294	$349,973	$361,828	$399,874	$443,853	$475,687
Farm Earnings	19,912	13,127	6,718	10,291	3,641	8,470	10,031	9,729
Total Nonfarm Earnings	211,447	237,412	318,576	339,682	358,187	391,404	433,822	465,958
Government Earnings	48,155	61,914	82,643	92,948	104,043	113,366	129,428	141,567
Total Federal	13,139	16,163	21,008	24,823	30,513	31,046	39,604	41,518
Federal Civilian	4,835	7,162	7,586	8,484	8,986	10,437	11,543	12,221
Military	8,304	9,001	13,422	16,339	21,527	20,609	28,061	29,297
State and Local	35,016	45,751	61,635	68,125	73,530	82,320	89,824	100,049
Private Nonfarm Earnings	163,292	175,498	235,933	246,734	254,144	278,038	304,394	324,391
Manufacturing	38,884	32,905	39,301	45,719	45,871	52,880	57,809	59,693
Mining	1,200	1,133	2,441	2,453	2,794	3,048	2,974	2,965
Contract Construction	14,600	18,102	28,190	23,901	22,933	25,260	28,625	28,632
Transportation/Communications/ Public Utilities	17,899	14,044	17,879	19,410	19,462	20,332	23,027	24,984
Wholesale and Retail Trade	50,204	57,406	70,241	74,024	74,086	80,052	87,360	94,762
Finance/Insurance/Real Estate	9,809	10,892	25,586	25,041	26,355	28,508	29,657	31,409
Services	28,816	38,745	49,625	53,347	60,043	65,224	71,739	78,707
Other	1,880	2,271	2,670	2,839	2,600	2,734	3,203	3,239

Source: Computerized data from the U.S. Department of Commerce, Office of Business Economics, Regional Economics Division.

The greatest percentage growth during the period occurred in Finance/Insurance/Real Estate Earnings (220%), Government Earnings (194%), Services (173%), and Mining (147%). Because of the relatively small base of Mining, this gain is not as significant as the other three.

Agricultural Earnings during the cited period have declined to less than half of the 1959 level and, as a share of Total Earnings, have dropped from 8.6% to 2.1%. Conversely, Total Nonfarm Earnings increased from 91.4% to 97.9% of Total Earnings.

In the Nonfarm sector, Transportation, Communications, and Utilities Earnings experienced the lowest percentage growth (39.6%), followed by Manufacturing Earnings with a growth of 53.5% between 1959 and 1970. Manufacturing Earnings dropped from 16.8% of Total Earnings to 12.6%. High concentrations in earnings include Government, with 29.8%; Trade, with 19.9%; and Services, with 16.6%.

Although Total Nonfarm Earnings increased in share of Total Earnings, the increased share of Government Earnings resulted in a net decrease in share of the private nonfarm sector.

The trends in earnings are more meaningful when compared with earnings trends for the total United States during the same years. These data are presented in Table 6.

Total Earnings nationally increased 101.4% from 1959 to 1970 compared to the 105.6% increase in Sonoma County. The growth and distribution trends of earnings in Sonoma County are somewhat dissimilar to those of the U.S. with the exception of one section, Construction. Manufacturing growth in earnings for Sonoma County was less than that of the U.S., 53.5% versus 85.4% and, as a percent of Total Earnings, Manufacturing comprises less than one-half of the U.S. ratio, 12.6% versus 27.8%.

Table 6

EARNINGS BY BROAD INDUSTRIAL SECTOR
UNITED STATES
(Millions of Dollars)

	1959	1962	1965	1966	1967	1968	1969	1970
TOTAL	$315,027	$357,613	$431,395	$471,187	$503,634	$550,251	$600,291	$634,357
Farm Earnings	14,118	15,800	17,507	18,864	17,594	17,603	19,843	19,116
Total Nonfarm Earnings	300,910	341,813	413,888	452,323	486,040	532,648	580,448	615,241
Government Earnings	44,470	54,455	67,490	75,679	83,453	93,188	101,470	112,099
Total Federal	21,306	24,634	28,955	32,870	35,953	39,749	42,429	45,520
Federal Civilian	12,618	15,194	18,325	20,107	21,758	24,156	25,808	28,571
Military	8,688	9,440	10,630	12,763	14,195	15,593	16,621	16,949
State and Local	23,165	29,821	38,535	42,809	47,500	53,439	59,041	66,579
Private Nonfarm Earnings	256,439	287,358	346,398	376,644	402,587	439,460	478,978	503,142
Manufacturing	94,973	105,979	127,696	141,479	148,129	161,613	174,550	176,075
Mining	4,560	4,501	4,894	5,097	5,346	5,600	5,852	6,582
Contract Construction	19,350	21,081	26,453	28,684	29,838	32,887	37,034	38,627
Transportation/Communications/ Public Utilities	24,255	26,312	30,797	33,080	35,062	37,997	41,681	44,943
Wholesale and Retail Trade	56,228	61,955	73,500	78,962	83,865	90,972	98,617	105,496
Finance/Insurance/Real Estate	16,036	18,161	21,858	23,305	25,778	28,898	31,071	33,210
Services	40,064	48,240	59,874	64,622	73,111	79,931	88,378	96,343
Other	973	1,129	1,326	1,415	1,458	1,562	1,795	1,866

Source: Computerized data from the U.S. Department of Commerce, Office of Business Economics, Regional Economics Division.

Sectors where Sonoma County growth exceeded national growth in earnings are Government, Mining, Finance/Insurance/Real Estate, and Services. Distribution of earnings of some of these sectors, however, are still out of proportion to national ratios. For example, Government earnings account for only 17.7% of total U.S. earnings but nearly 30% of Sonoma County total earnings. Trade accounts for 19.9% of Sonoma County total earnings, whereas it accounts for only 16.6% nationally.

An indication of import/export levels of various industry sectors for Sonoma County is provided in Table 7. The data presented are location quotients for earnings in each industry sector. A value above 1.0 implies a net export of goods or services of an industry in Sonoma County, whereas a value below 1.0 implies a net import of goods or services in an industry. These quotients are based on the concentration of earnings of a given industry in Sonoma County relative to the concentration of earnings for that industry nationally and assume consumption patterns are the same in a given local as they are nationally.

Sonoma County has a well-balanced import/export relationship for Total Nonfarm earnings. However, there is a substantial dependence on other locales to provide the agricultural requirements of the area, primarily meat, fish, and vegetable crops. With the exceptions of Manufacturing, Mining, and Transportation/Communications/Utilities, the Nonfarm sectors are all near or well over an import/export balance. The Government sector, both Federal and State and local, is well over an import/export balance.

According to Airport Management, some of the major local industries which use the aviation services offered at Sonoma County Airport are:

Table 7

INDICATORS OF EXPORT*
SONOMA COUNTY

	1959	1962	1965	1966	1967	1968	1969	1970
TOTAL EARNINGS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Farm Earnings	1.9219	1.1855	0.5099	0.7350	0.2894	0.6625	0.6828	0.6811
Total Nonfarm Earnings	0.9568	0.9914	1.0207	1.0110	1.0257	1.0112	1.0109	1.0099
Government Earnings	1.4738	1.6225	1.6247	1.6538	1.7351	1.6736	1.7254	1.6842
Total Federal	0.8402	0.9361	0.9627	1.0158	1.1807	1.2355	1.2617	1.2159
Federal Civilian	0.5212	0.6729	0.5482	0.5667	0.5741	0.5945	0.6047	0.5711
Military	1.3007	1.3598	1.6789	2.1956	2.1099	1.8198	2.2816	2.3071
State and Local	2.0585	2.1894	2.1221	2.1419	2.1548	2.1205	2.0569	2.0029
Private Nonfarm Earnings	0.8671	0.8718	0.9032	0.8819	0.8787	0.8705	0.8595	0.8597
Manufacturing	0.5575	0.4430	0.4081	0.4349	0.4311	0.4501	0.4477	0.4521
Mining	0.3586	0.3571	0.6637	0.6481	0.7264	0.7451	0.6907	0.5962
Contract Construction	1.0277	1.2275	1.4144	1.1215	1.0709	1.0569	1.0454	0.9885
Transportation/Communications/ Public Utilities	1.0052	0.7622	0.7703	0.7906	0.7730	0.7352	0.7478	0.7415
Wholesale and Retail Trade	1.2157	1.3227	1.3262	1.2619	1.2300	1.2111	1.1978	1.1978
Finance/Insurance/Real Estate	0.8330	0.8563	1.5523	1.4465	1.4219	1.3581	1.2896	1.2595
Services	0.9796	1.1460	1.0994	1.1116	1.1426	1.1225	1.0978	1.0895
Other	2.6129	2.8438	2.6452	2.7000	2.4828	2.4286	2.4000	2.3448

* Location Quotient for Total Earnings.

Source: Computerized data from the U.S. Department of Commerce, Office of Business Economics, Regional Economics Division.

Electro-Victor	Forestville
H and N, Inc.	Petaluma
Windsor Vineyards	Healdsburg
Orbitex	Sebastopol
Hewlett-Packard	Santa Rosa
Fairchild Semiconductor	Healdsburg
Optical Coating Laboratory, Inc.	Santa Rosa
Heller Laboratories	Santa Rosa
Optical Engineering	Santa Rosa
Fab-Tek	Healdsburg
MGM Brakes, Inc.	Cloverdale
Optoelectronics, Inc.	Petaluma

Income

Total personal income for Sonoma County has steadily increased since 1962, rising from $356 million in that year to $804 million in 1971, an increase of 126% (Table 8). The greatest dollar increase was in Wage and Salary Disbursements, reflecting the growth of labor-oriented industry.

Of the total net gain realized over the period cited in Table 8, 50.9% has been in Wage and Salary Disbursements. If Other Labor Income (which is primarily employer contributions to private pension funds) is added, 54.2% of Total Personal Income growth is taken into account. Together, these categories have remained almost constant as a percentage of Total Personal Income.

Proprietors' Income declined from 17.4% to 10.0% of Total Personal Income, indicating a reduction in the relative importance of privately-owned enterprises in Sonoma County. Property Income increased slightly in share of total, from 18.8% to 20.0%.

Transfer payments recorded the highest percentage growth for the period (221%), reflecting an increase in the concentration

Table 8

PERSONAL INCOME BY SOURCE
1962 - 1971
(Millions of Dollars)

Year	Wages & Salaries[1]	Other Labor Income	Proprietors' Income	Property Income	Transfer Payments	Total[2]	% Change From Previous Year
			SONOMA COUNTY				
1962	$ 177	$ 8	$ 62	$ 67	$ 42	$ 356	7.6%
1963	198	9	62	79	47	395	11.0%
1964	225	10	68	86	51	440	11.4%
1965	242	12	68	95	58	474	7.7%
1966	256	13	69	105	67	509	7.4%
1967	270	13	69	112	77	540	6.1%
1968	303	14	76	123	87	603	11.7%
1969	335	17	77	135	98	662	9.8%
1970	362	19	76	143	118	718	8.5%
1971	405	23	80	161	135	804	12.0%
			STATE OF CALIFORNIA				
1962	$31,687	$1,438	$5,370	$6,833	$3,723	$49,051	7.4%
1963	33,841	1,575	5,544	7,566	4,089	52,615	7.3%
1964	36,290	1,753	5,992	8,133	4,402	56,570	7.5%
1965	38,612	1,944	6,060	8,719	4,899	60,234	6.5%
1966	42,188	2,190	6,155	9,327	5,348	65,208	8.3%
1967	45,122	2,354	6,243	9,865	6,352	69,936	7.3%
1968	49,600	2,608	6,738	10,733	7,221	76,901	10.0%
1969	53,958	2,950	6,753	11,389	8,142	83,192	8.2%
1970	56,815	3,184	6,709	12,172	9,945	88,825	6.8%
1971	58,971	3,541	7,034	12,964	11,608	94,118	6.0%

Notes: 1/ Net of social insurance contributions.
2/ May not add due to rounding.

Source: California State Department of Finance.

of retirees and/or persons receiving welfare or benefit payments in Sonoma County. Some of the increase in this sector is also attributable to the increased social welfare benefits available now as compared to 1962.

When compared to the State of California, Sonoma County growth rates become more meaningful. County growth exceeded State growth in all categories of Personal Income except Proprietors' Income. Wage and Salary growth for Sonoma County was 129%, compared to 86% for the State. Property Income grew by 140%, compared to 90% for the State. A comparison with State levels also indicates that the growth in Transfer Payments Income in Sonoma County is in line with the balance of California. However, as a percent of Total Personal Income, it is somewhat higher -- 16.8% for the County compared to 12.3% State-wide.

As illustrated by the following tabulation, median-family incomes are somewhat higher in the City of Santa Rosa than they are in the balance of the County.

INCOME CHARACTERISTICS
Sonoma County
1969

Family Income	City of Santa Rosa	%	Balance of County	%	Total County	%
$ 0 - $9,999	5,956	44.7	21,673	54.7	27,619	52.1
$10,000-$14,999	4,040	30.3	10,928	27.6	14,968	28.3
$15,000 or More	3,335	25.0	7,004	17.7	10,349	19.6
Total	13,331	100.0	39,605	100.0	52,936	100.0
Median-Family Income	$10,763		$ 9,312		$ 9,673	

By way of comparison, median-family income for the State of California was $10,732 in 1969 and for the U.S. was $9,764 (Statistical Abstract of the United States, 1972). As can be seen, the median income for families in the City of Santa Rosa was slightly above the State median and considerably higher than the national median in 1969. On the County level, however, the median was lower than both.

Per capita income in Sonoma County has increased steadily since 1965, rising from $2,516 to $3,500 in 1970 for a growth of 39.1%, and is expected to rise to about $4,900 by 1980 according to the forecasts prepared by the Bank of America (Focus on Sonoma County, January 1973). Although $4,900 will approximate the national average in 1980, it will be below the State average. According to Sales Management, Survey of Buying Power figures, effective buying income of Sonoma County residents increased by some 23% during this same period (1965-1970).

The Bank of America study predicts an 85.2% increase in real personal income (in 1970 dollars) by 1980. The Association of Bay Area Governments' RASS study projects an increase of 101.3% for the same period. The difference between these two projections is a matter of timing (i.e., the RASS forecast would be reached less than two years later if the Bank of America annual growth rate was actually realized).

Because total employment in Sonoma County by 1980 has been projected at a higher level than assumed by the Bank of America in its forecasts, the income level projected by RASS is felt to be more likely and better suited for projecting aviation requirements for Sonoma County. Personal income projections for Sonoma County are presented in the following tabulation.

PERSONAL INCOME PROJECTIONS
Sonoma County
(Millions of Dollars)

Year	Income
1975	1,000
1980	1,445
1985	2,096
1995*	4,408

* Extrapolation of RASS projection

Source: Association of Bay Area Governments' Regional Airports System Study (RASS)

Summary

The definition of the term "economic base" has evolved as a description of the basic or primary activities by which an economic subdivision attracts revenue. These basic activities vary widely from area to area, and the proportions of revenue derived from the activities range from extreme dependence upon a single activity to broad diversification. Many areas depend heavily on one activity such as tourism, the presence of one dominant industry, or a recreational facility, while others have widely diverse bases with no domination by a particular activity.

Sonoma County is in the midst of economic transition. Long the leading agricultural county of the Bay Area, Sonoma County is changing from a rural to an urban area. The wine industry is a key element in the County's public image and is a major tourist attraction, drawing more than a million visitors a year to the wineries. The only operating geothermal power plant in North America, using underground steam to spin the turbine generators that produce electrical power, is located in northern Sonoma County. An ongoing expansion plan of this multi-million dollar facility calls for capacity increases by 1975 in an amount sufficient to serve a city about the size of San Francisco.

Livestock and poultry and their products are also very important to the economy of Sonoma County.

Sonoma County's abundance of beaches, parks, and recreational areas make it one of the most appealing vacation areas in California. State parks alone attracted more than 1.9 million visitors in the year from July 1971 to June 1972. The tourist industry plays an important role in the Sonoma County economy and can be expected to show substantial growth in the years ahead when planned projects, such as the Warm Springs Dam-Lake Sonoma project, are completed. This site alone is expected to attract some two million visitors a year.

It should be noted that although the growing tourism industry within Sonoma County should have positive influence on total economic growth in the County, it is not the type of tourism that normally has a significant effect on air transportation demand such as a Disneyland type attraction would.

The Sonoma County Airport Air Trade Area has an economic base which has in the past been greatly influenced by fluctuations within the agricultural, wood products, and tourist industries. Although these industries are expected to continue to dominate Sonoma County's economic activity, a move toward greater dependence on trade, service, government, and light manufacturing employment sectors is expected. The result will be a more stable employment profile, reducing the dominance of seasonal work in the County's economy.

Population growth in recent decades has exceeded that of the State and Nation, and this trend is expected to continue through the study period. Since the arly 1960's, total employment in Sonoma County has grown at a rate in excess of the State and Nation. This trend is also expected to continue at an accelerated rate for at least the next decade as new light industry is attracted to the fairly large pool of unemployed, unskilled labor and low-cost industrial land.

The growth rate of industrial earnings in Sonoma County exceeded that of the total U.S. during the past decade, and the same is true of total personal income. As a result of the growth in personal income, Sonoma County is expected to go from a position of below average per capita income to one of approximate parity with the Nation. Per capita income, however, is expected to stay below the State-wide average.

As a result of the foregoing analyses, demand for air transportation services and facilities at Sonoma County Airport is anticipated to increase at a rate in excess of the national average.

HISTORICAL AVIATION ACTIVITY

Prior to April 1968, Sonoma County Airport was served by Pacific Airlines. In that month, Pacific Airlines, Bonanza Airlines, and West Coast Airlines merged to become Air West, Inc., which subsequently became Hughes Airwest. In January 1969, a third-level air carrier, Golden West Airlines, initiated service at Coddington Airport and moved its operations to Sonoma County Airport in December 1971 when Coddington closed. A second third-level air carrier, Golden Pacific Airlines, began service in March 1969 at Sonoma County Airport. Both of these carriers ceased operations at the County Airport in September 1972. Simultaneously with their departure in September 1972, STOL Air, Inc., commenced feeder/commuter operations at the Airport.

Passenger Activity

Historical passenger enplanement volumes within the County are set forth in Table 9. It can be seen that these volumes experienced positive, if erratic, growth from 1962 through 1967. This trend was reversed in 1968 when Air West reduced the number of average weekly departures from 26 to 21 in 1967.

The significant growth (239.2%) in 1969 was due to several factors. Golden Pacific Airlines inaugurated service to 10

Table 9

HISTORICAL PASSENGER ENPLANEMENTS
Sonoma County Airport

Year	Passenger Enplaned: Certificated Carrier	Passenger Enplaned: Commuter Operators	Passenger Enplaned: Total	% Change Total
1962	2,280	--	2,280	--
1963	2,880	--	2,880	+ 26.3
1964	2,916	--	2,916	+ 1.3
1965	3,914	--	3,914	+ 34.2
1966	4,241	--	4,241	+ 8.4
1967	4,993	--	4,993	+ 17.7
1968	4,556	--	4,556	- 8.8
1969	2,570	12,882 1/	15,452	+239.2
1970	1,443	19,857 1/	21,300	+ 37.8
1971	666	14,795 1/	15,461	- 27.4
1972	1,714	6,592	8,306	- 46.3
1973	1,712	6,839	8,551	+ 3.0
1974	1,486	23,526	25,012	+292.5

1/ Includes passenger enplanements at Coddington Airport

Note: Hughes Airwest work stoppage -- December 15, 1971 - March 13, 1972; Hughes Airwest discontinued service in August 1974.

Sources: CAB/FAA Airport Activity Statistics of Certificated Route Air Carriers, 1962-1974.

Airport Management Records, 1969-1974, Commuter activity.

California cities and Golden West Airlines commenced scheduled service to San Francisco from Coddington Airport. A significant share of the total County enplanements were attracted to Coddington Airport because of its proximity to downtown Santa Rosa.

In 1971, the growth trend reversed itself and total County enplanements experienced a decrease of 27.4%. This is attributed to: (1) a decrease in direct-plane service from eight cities in 1970 to four in 1971, (2) a decrease in Hughes Airwest flight frequency from 620 annually in 1970 to 421 in 1971, and (3) the move of Golden West from Coddington to the County Airport when Coddington Airport closed.

Because of the relatively small passenger data base, annual fluctuations can be expected to demonstrate a greater degree of variance.

Origin-Destination Patterns

A summary of the origin-destination patterns of Sonoma County Airport's air passengers for the survey periods 1967, 1969, and 1971 is set forth in Table 10. Only those cities with 1.0% or more of passenger traffic at Sonoma County Airport are included in this summary. It should be noted that these data are collected in 10% samples; therefore, the numbers will not correspond to the actual number of enplaned passengers at the Airport for the years cited.

Origin-destination data are based on actual airline ticket sales and indicate the ultimate airport city to which the passenger is destined without regard to whether he makes the entire journey on one aircraft of one airline or changes aircraft and/or airlines one or more times to reach his destination.

Unfortunately, an analysis of origin-destination patterns based on the 10% sample is inconclusive for travel patterns for Sonoma County Airport for the following reasons: (1) the sample is based

Table 10

SUMMARY OF ORIGIN-DESTINATION PATTERNS
(As A Percent of Sonoma County Passengers)

City of Origin or Destination	Air Miles	10% Sample - 1971 Passengers Number	%	Rank	10% Sample - 1969 Passengers Number	%	Rank	10% Sample - 1967 Passengers Number	%	Rank
Los Angeles	407	149	16.3	1	186	18.7	1	151	16.1	3
San Francisco	55	61	6.6	2	96	9.7	3	202	21.6	2
New York	2,576	53	5.7	3	12	1.2	15	--	--	--
Phoenix	698	44	4.8	4	--	--	--	--	--	--
Seattle	620	39	4.2	5	46	4.6	5	19	2.0	8
Portland	489	37	4.0	6	95	9.6	4	61	6.5	4
Denver	966	29	3.1	7	17	1.7	10	11	1.2	12
Chicago	1,856	28	3.0	8	19	1.9	9	10	1.1	13
Fresno	208	25	2.7	9	16	1.2	12	12	1.3	10
Salt Lake City	599	25	2.7	9	11	1.1	16	--	--	--
Santa Barbara	326	25	2.7	9	14	1.4	13	13	1.4	9
Honolulu	2,395	21	2.3	12	--	--	--	--	--	--
Las Vegas	454	21	2.3	12	21	2.1	8	--	--	--
Ontario	424	19	2.1	14	11	1.1	16	--	--	--
Dallas	1,519	15	1.6	15	--	--	--	--	--	--
Reno	177	13	1.4	16	41	4.1	6	27	2.9	6
Washington, D.C.	2,437	13	1.4	16	--	--	--	--	--	--
Des Moines	1,553	11	1.2	18	--	--	--	--	--	--
St. Louis	1,746	10	1.1	19	--	--	--	--	--	--
Boise	490	9	1.0	20	--	--	--	--	--	--
Minneapolis	1,583	9	1.0	20	--	--	--	--	--	--
Eureka/Arcata	184	--	--	--	114	11.5	2	238	25.4	1
Sacramento	66	--	--	--	28	2.8	7	--	--	--
San Diego	509	--	--	--	17	1.7	10	26	2.8	7
San Jose	88	--	--	--	13	1.3	14	--	--	-
Crescent City	238	--	--	--	--	--	--	46	4.9	5
Riverside	422	--	--	--	--	--	--	12	1.3	10
Sub-total:		656	71.0		757	76.2		828	88.4	
All Others		268	29.0		237	23.8		109	11.6	
TOTAL:		924	100.0		994	100.0		937	100.0	

Note: Only those cities with 1.0% or more of passenger traffic have been ranked. Commuter and air taxi passenger traffic not reported to the Civil Aeronautics Board.

Source: ATA/CAB, Origin-Destination Survey of Airline Passenger Traffic, Table 8.

Note: Only those cities with 1.0% or more of passenger traffic have been ranked. Commuter and air taxi passenger traffic not reported to the Civil Aeronautics Board.

Source: ATA/CAB, Origin-Destination Survey of Airline Passenger Traffic, Table 8.

on tickets sold by certificated air carriers only, in this case, Hughes Airwest; (2) Airwest accounted for only 4.3% of total passengers enplaned at Sonoma County and Coddington airports in 1971, 6.8% in 1970, and 16.6% in 1969; and (3) through-plane service patterns were severely curtailed in 1970 when Airwest cancelled service to Los Angeles, Portland, and Reno all via intermediate cities.

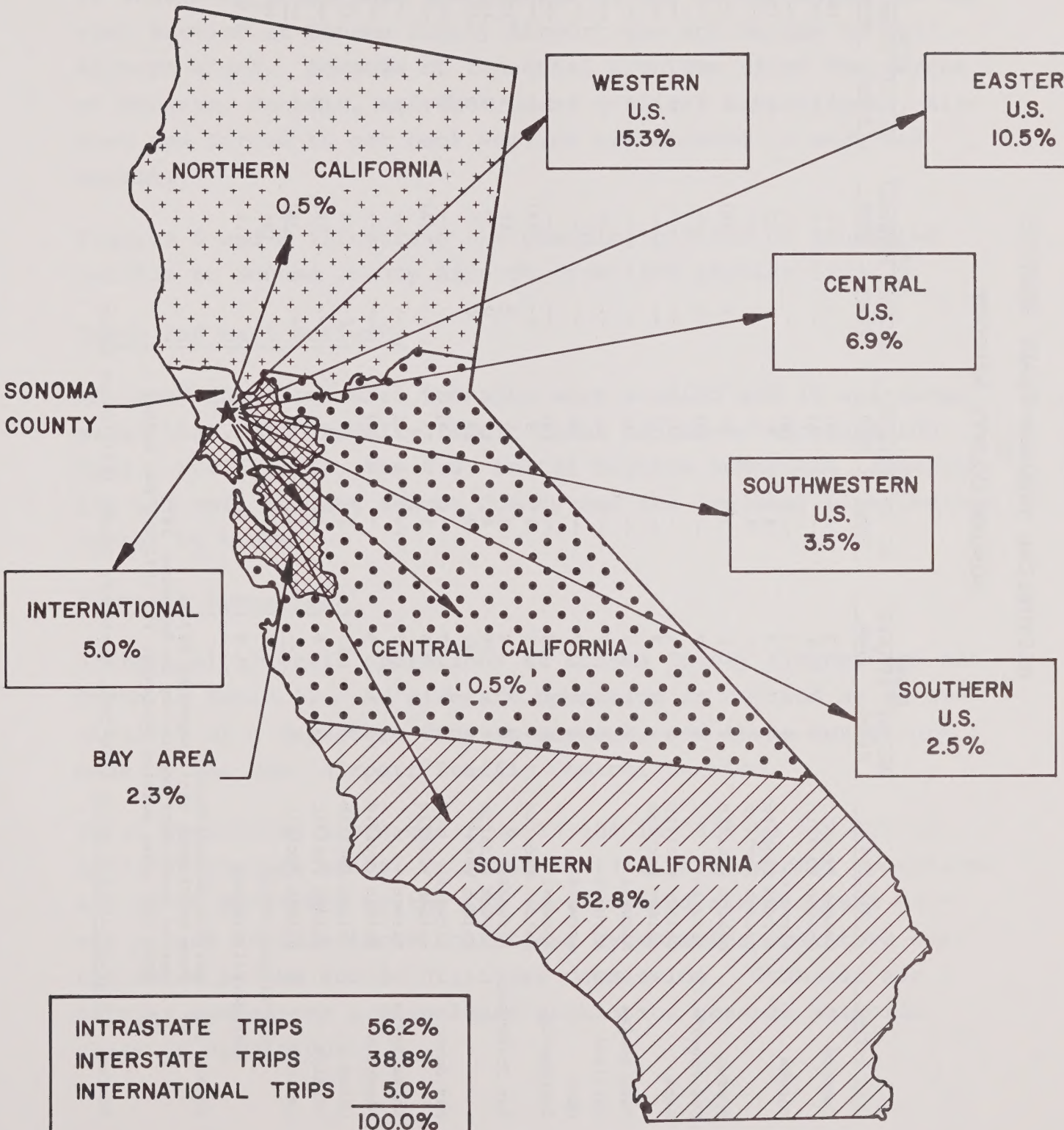
A more descriptive picture of Sonoma County origin-destination patterns is provided by an evaluation of passenger trips between Sonoma County and other locations as prepared by the California Department of Aeronautics for the California Master Plan of Aviation. The State study is based on a survey of 1970 origin-destinations of passengers at all California airports with scheduled airline service.

A distribution of total passenger trips by region is presented in Figure 4. It should be noted that the large majority of these air passengers began or ended their trip from/to Sonoma County via ground transportation from other airports.

Table 11 presents the number of nonstop, one-stop, and two-or-more stops, single-plane scheduled weekly air carrier and commuter airline flights to Sonoma County Airport for the period 1969 to 1973. It is evident from this table that scheduled airline service to Sonoma County Airport has been deteriorating since 1969. In 1969, the Airport enjoyed single-plane service from 15 cities with some 32 arrivals per day. In 1970, single-plane service was only offered from 8 cities and average daily arrivals were reduced to less than 18. By 1972, direct service had been eliminated from all cities except San Francisco and average daily frequencies were down to 6.6 per day.

As of December 1973, the only CAB scheduled air carrier service to Sonoma County Airport is from San Francisco on Airwest. One departure per weekday is direct to San Francisco and the other is to San Francisco via Sacramento; however, single-plane return

SCHEDULED PASSENGER TRIP PATTERNS



INTRASTATE TRIPS	56.2%
INTERSTATE TRIPS	38.8%
INTERNATIONAL TRIPS	5.0%
	100.0%

FIGURE 4

Table 11

HISTORICAL THROUGH-PLANE SERVICE TO SONOMA COUNTY AIRPORT

City Served	Airline	1969		1970		1971		1972		1973	
		No. of Stops	Flights/ Week	No. of Stops	Flights/ Week	No. of Stops	Flights/ Week	No. of Stops	Flights/ Week	No. of Stops	Flights/ Week
Concord	Golden Pacific	1	7	--	(A)	1	5	--	(A)	--	--
	Golden Pacific	2	6	--	(A)	--	--	--	--	--	--
Eureka	Airwest	0	7	--	(A)	--	--	--	--	--	--
	Golden Pacific	1	7	0	5	1	13	--	(A)	--	--
	Golden Pacific	--	--	2	5	--	--	--	--	--	--
Fresno	Golden Pacific	2	6	3	5	--	(A)	--	--	--	--
Los Angeles	Airwest	4	7	--	(A)	--	--	--	--	--	--
Napa	Golden Pacific	1	6	--	(A)	--	--	--	--	--	--
	Golden Pacific	2	7	--	(A)	--	--	--	--	--	--
Paso Robles	Airwest	2	7	--	(A)	--	--	--	--	--	--
Portland	Airwest	1	7	--	(A)	--	--	--	--	--	--
Reno	Airwest	1	7	--	(A)	--	--	--	--	--	--
Sacramento	Airwest	0	14	--	(A)	--	--	--	--	--	--
	Golden Pacific	1	6	2	5	--	(A)	--	--	--	--
San Francisco	Airwest	0	7	0	10	0	10	0	10 2/	0	10 3/
	Golden Pacific	0	36	0	40	0	38	0	13 2/	1	31 3/
	Golden West 1/	0	41	0	33	0	37	0	23 2/	--	--
San Jose	Airwest	1	7	--	(A)	--	--	--	--	--	--
	Golden Pacific	1	6	1	5	--	(A)	--	--	--	--
Santa Maria	Airwest	3	7	--	(A)	--	--	--	--	--	--
Stockton	Golden Pacific	1	6	--	(A)	--	--	--	--	--	--
Ukiah	Golden Pacific	0	13	1	5	0	6	--	(A)	--	--
Visalia	Golden Pacific	3	6	4	5	--	(A)	--	--	--	--
Salinas	Golden Pacific	--	--	1	5	--	(A)	--	--	--	--
Total Flights/Week			223		123		109		46		41
Average Flights/Day			31.9		17.6		15.6		6.6		5.9

Notes: (A) Service discontinued
1/ From Coddington until December 1971
2/ Ceased operations completely in September 1972
3/ STOL Air began service September 18, 1972 via San Rafael

Source: Official Airline Guide 1969-1972, September issue; 1973, March issue

service is not provided. STOL Air offers nine scheduled feeder/commuter flights per day to/from San Francisco with a flag stop at San Rafael and single-plane service to/from Napa and Concord.

It should be noted that the decline in CAB certificated air carrier service at Sonoma County Airport was not unique to this Airport alone. Because of financial problems after the merger of Bonanza, Pacific, and West Coast airlines into Airwest, Airwest was forced to cut back service system-wide in marginal markets.

Figures 5 and 6 illustrate the changing pattern of scheduled service to Sonoma County Airport from 1960 through 1973.

Cargo and Mail Activity

Enplaned cargo and mail tonnages were studied and it was determined that, historically, their total has never exceeded 100 tons. During 1968, the U.S. Postal Service commenced transporting all mail between Sonoma County and the Regional Distribution Center by truck.

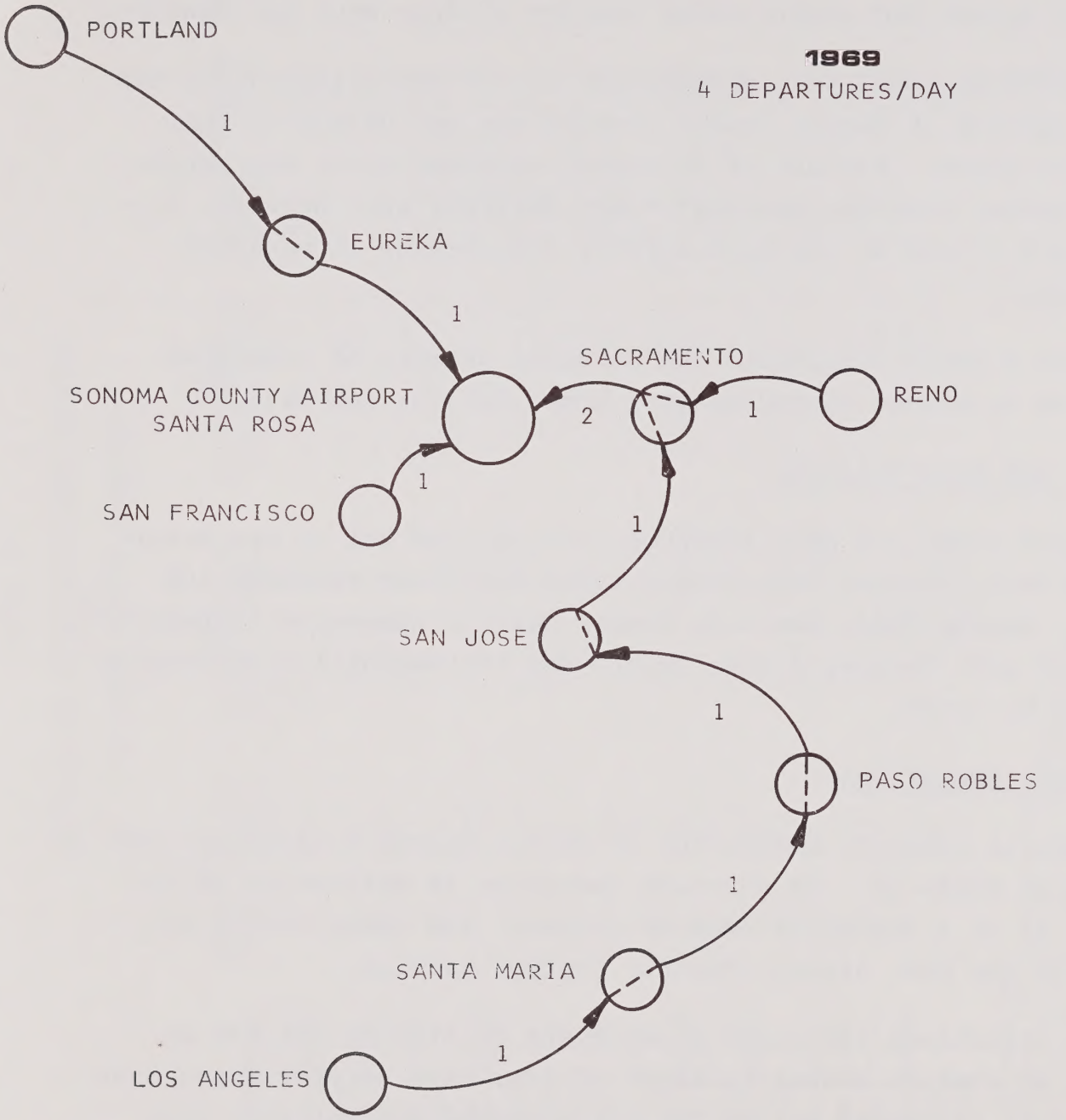
Aircraft Operations

Historical aircraft operations at Sonoma County Airport are set forth in Table 12. An aircraft operation is defined as an arrival at or a departure from an airport, and these counts are made by the FAA, Airport Traffic Control Service.

Total operations increased from 29,904 in 1963 to 144,078 in 1973, an average annual increase of 17%. Air carrier operations are those performed by the CAB certificated air carriers only and do not include those operations by commuter operators certificated by the Public Utilities Commission. Commuter air carrier operations are included within the general aviation class of operations.

AIR CARRIER SERVICE PATTERN FROM SONOMA COUNTY AIRPORT

HUGHES AIRWEST, INC.
SANTA ROSA, CALIFORNIA



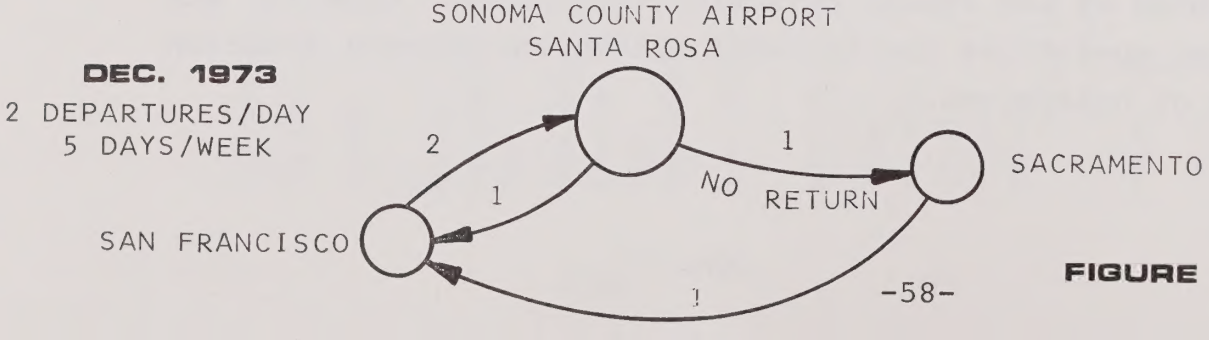


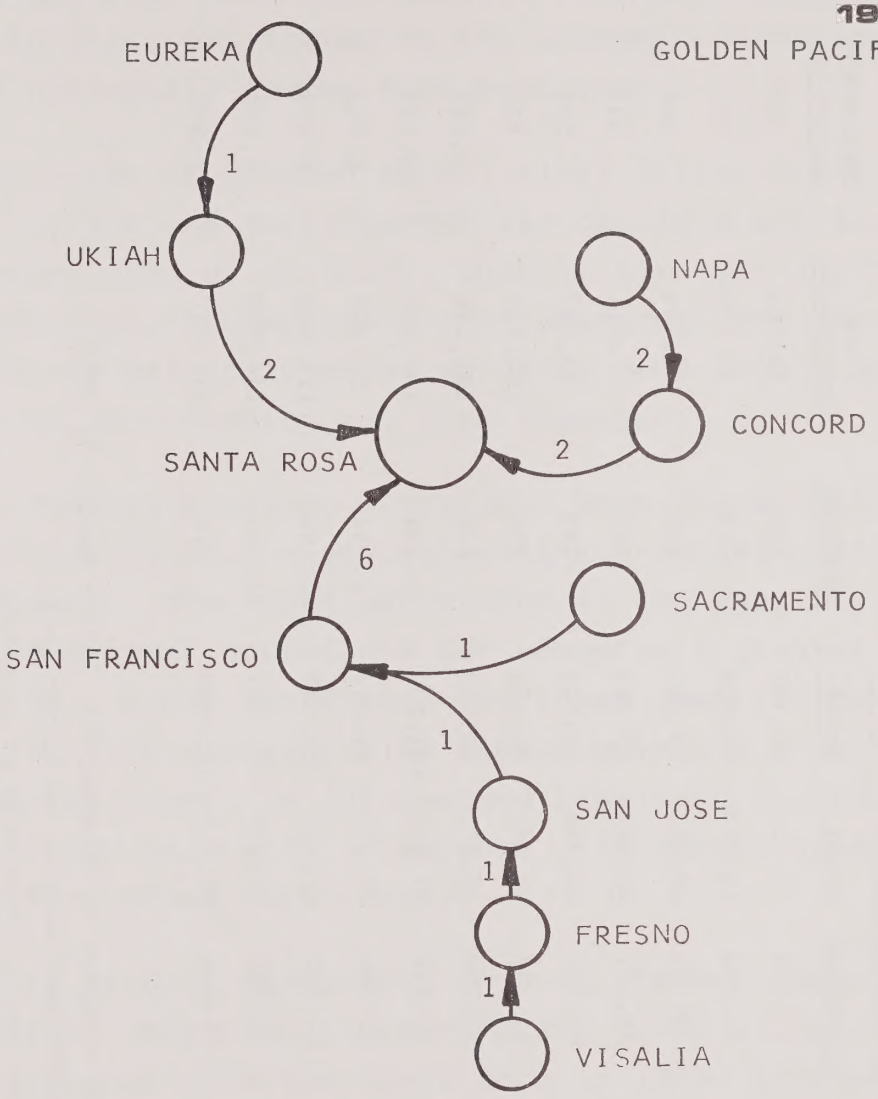
FIGURE 5

COMMUTER SERVICE PATTERN TO SONOMA COUNTY AIRPORT

SANTA ROSA, CALIFORNIA

1968

GOLDEN PACIFIC AIRLINES



DEC. 1973

STOL-AIR

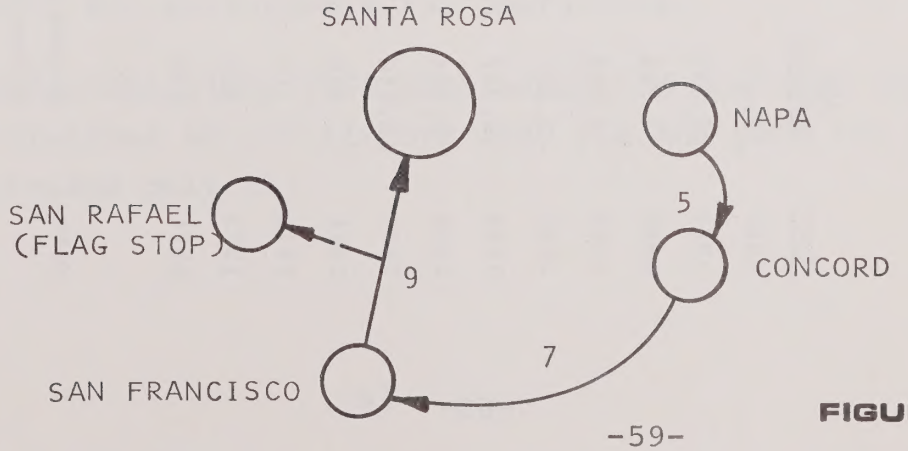


FIGURE 6

Table 12

HISTORICAL AIRCRAFT OPERATIONS
Sonoma County Airport

Year	Air Carrier	General Aviation				Military	Total Operations	Instrument Approaches	Instrument Operations
		Commuter Airline	Itinerant	Local	Total				
1963	2,607	--	17,948	8,759	26,707	590	29,904	292	1,526
1964	2,583	--	21,036	14,764	35,800	719	39,102	183	1,573
1965	2,516	--	30,115	18,627	48,742	866	52,124	449	2,994
1966	2,534	--	40,157	28,860	69,017	500	72,051	346	3,400
1967	2,697	--	45,006	38,916	83,922	743	87,362	540	3,598
1968	2,227	--	55,734	43,320	99,054	896	102,177	835	4,201
1969	2,084	3,678	55,758	39,472	98,908	804	101,796	1,690	7,345
1970	1,240	4,710	58,648	37,875	101,233	1,284	103,757	1,754	6,266
1971	844	3,150	53,866	37,333	94,349	1,214	96,407	1,013	4,093
1972	716	2,780	62,998	47,010	112,788	1,160	114,664	1,474	5,625
1973	912	4,193	75,947	61,514	141,654	1,512	144,078	1,420	7,562
1974	624	6,722	79,828	58,915	145,465	918	147,007	1,840	9,656

Notes: Hughes Airwest work stoppage -- December 15, 1971 - March 13, 1972.
Hughes Airwest discontinued service in August 1974.
1974 statistics made available at time of printing.

Source: FAA, Air Traffic Activity

Growth in general aviation activity at the Airport has been generally upward, particularly in itinerant operations which increased every year from 1963 to 1972 with one exception, 1971. This is, in part, attributed to the economic conditions which prevailed nationally during that same year.

General aviation is defined as all civil flying other than that performed by the CAB certificated air carriers and includes numerous diverse uses of aircraft, such as air taxi service, flying for pleasure, transportation of personnel and cargo by business firms via privately-owned aircraft, and highly specialized uses such as crop-dusting and fire fighting.

Itinerant general aviation operations have historically averaged approximately 60% of the general aviation activity at Sonoma County Airport. The trend prevailing in the past few years, however, is that local operations are becoming a greater percentage of the total. Local operations are those that (1) operate within the local traffic patterns, (2) remain within a 20-mile radius of the control tower, or (3) execute simulated instrument approaches or low passes at an airport. Itinerant operations are all operations other than local.

According to Airport Management records, feeder/commuter airline itinerant operations accounted for 3,678 of the total itinerant general aviation operations in 1969; increased to 4,170 in 1970 and thereafter declined to 3,150 in 1971 and 2,066 in 1972 when both Golden Pacific and Golden West airlines ceased operations at the Airport and were replaced by STOL Air. During 1973, STOL Air performed 4,193 operations.

Military operations since 1963 have accounted for less than 2% of total operations at the Airport and, for the past few years, have approximated only 1%.

IFR Activity

The Instrument Flight Rules (IFR) activity at Sonoma County Airport is presented in Table 12. IFR activity is recorded in two related, yet different, categories.

An IFR approach is recorded for each IFR arrival in weather conditions such that a portion of the approach is actually made on instruments, i.e., whenever the ceiling is below the altitude where the approach is initiated or the visibility is less than three miles. With respect to Sonoma County Airport, Table 12 shows that the percent of general aviation aircraft operations in periods of bad weather has generally been increasing, which is an indication of the increased sophistication of the aviation fleet utilizing Sonoma County Airport and the installation of additional landing aids at the Airport.

An IFR operation is recorded for every aircraft arriving or departing on a filed instrument flight plan, independent of weather conditions. The filing of an IFR flight plan is standard procedure for air carrier and military operations and an increasingly large number of general aviation operations, particularly those of corporate aircraft. The number of IFR operations at Sonoma County Airport has also been increasing.

In 1974, Sonoma County Airport ranked 221st in instrument approaches and 315th in instrument operations when compared to U.S. airports with air traffic control towers.

Civil Aircraft

According to the Sonoma County Tax Assessor's records, there were 472 aircraft based in the County in March 1973. Of this

total, 79.5% belonged to residents of the County, 16.8% to residents of the other Bay Area counties, and 3.6% to other California residents or out-of-state owners.

Of the 472 aircraft based in Sonoma County as of March 1973, 227, or 48.1%, were based at Sonoma County Airport and, of these, 89.4% belonged to residents of Sonoma County, 6.2% to residents of other Bay Area counties, and 4.4% to owners outside of these areas. Some 60% of the aircraft based at Sonoma County Airport are for private use, approximately 21% are for business use, and the remainder belong to fixed base operators, flying clubs, and special users, such as fire fighting and the Civil Air Patrol.

The growth of aircraft based at Sonoma County Airport is presented below. As can be seen from these figures, the number of based aircraft at the Airport increased by more than 100 during the last four years.

BASED AIRCRAFT
Sonoma County Airport

As of December	Number
1962	74
1963	73
1964	71
1965	69
1966	97
1967	123
1968	130
1969	142
1970	167
1971	206
1972	238
1973	253
1974	267

Source: Airport Management Records.

According to a report prepared by A. D'Arcy Harvey for the FAA in 1972, Relationships Between General Aviation Aircraft and Population, Sonoma County (Santa Rosa SMSA) has the eleventh highest ratio of general aviation aircraft per 10,000 residents of all SMSA's in the 100,000 to 249,999 population range. Sonoma County's ratio was 11.1 aircraft per 10,000 population based on 1970 population and December 1969 registered aircraft statistics. The average for the 109 comparable SMSA's in 1970 was 6.9 per 10,000 population.

Summary

Passenger enplanements at Sonoma County Airport showed a positive growth through the 1962-1968 period. The pronounced growth that occurred in 1969 and the fluctuations since that year were caused by the introduction and then cancellation of scheduled commuter services at Sonoma County and Coddington airports, as well as the curtailment of single-plane service by Airwest to many cities. It can readily be seen that commuter air service from Sonoma County has had a significant impact on passenger enplanements.

Air carrier service at the Airport has been on the decline since 1969 when single-plane service was available from 15 cities. During 1973, single-plane service was only available to five cities, San Francisco, Sacramento, Concord, Napa, and San Rafael.

Tons of cargo enplaned at Sonoma County Airport increased steadily from 1962 to 1971 but remained at insignificant levels.

The number of civil aircraft based at Sonoma County Airport has been increasing at a very significant rate with the greatest growth occurring in the smaller, single-engine type aircraft used for business and pleasure purposes. There has also been a marked increase in the number of sophisticated multi-engine aircraft at the Airport.

V - AVIATION DEMAND FORECASTS

In order to plan effectively the facilities that will be required to accommodate aviation activity at Sonoma County Airport, it is first necessary to assess the probable demand for such facilities that may be expected to occur.

Terminal, runway, hangar, and other facility requirements can be determined from forecasts of passenger, cargo, and aircraft operations. Airport planning should be predicated on 20-year forecasts; therefore, forecasts of aviation activity at Sonoma County Airport have been developed for the period through 1995.

Forecasting of air passenger traffic at Sonoma County Airport is complicated by the uncertainties surrounding the potential development of Napa County Airport or Hamilton Air Force Base as North Bay service points as recommended by the Association of Bay Area Governments' Regional Airport System Study (RASS).

The RASS study estimates that if Hamilton were to be developed as a regional airport it would attract 90% of Sonoma County, California Corridor traffic and, if Napa Airport were to be developed (in lieu of Hamilton), it would attract 50% of Sonoma County traffic in the California Corridor. By way of comparison, the RASS study estimates that if Sonoma County Airport were developed as the North Bay regional airport, it would only attract 20% of Marin County and 60% of Napa County California Corridor passengers. RASS estimates that 35% of total Bay Area local passengers will have origin/destinations in the California Corridor by 1985.

All of the foregoing percentages are based on diversion of traffic from San Francisco and Oakland airports and do not include those local passengers who have historically used Sonoma County Airport. It is reasonably safe to assume that if either Hamilton or Napa airports are developed and jet service is offered

from either airport to points in Southern California that diversion from Sonoma County Airport itself will result.

For this reason, two forecasts of enplaned passengers at Sonoma County Airport are required; one assuming the development of Hamilton Air Force Base or Napa County Airport and the other assuming the converse. All other forecasts (i.e., aircraft operations) assume that neither Hamilton nor Napa are developed as regional air carrier airports.

Forecasting of air passenger traffic at Sonoma County Airport is further complicated by its proximity to San Francisco and Oakland airports (approximately 75 miles) and the use of these facilities by the large majority of Sonoma County resident passengers. According to the RASS study, 185,000 passengers from Sonoma County use either San Francisco or Oakland airports in 1968. Sonoma County Airport accounted for 9,112 passengers (2 x 4,556 enplanements) in the same year, or 4.7% of the total (185,000 + 9,112).

The diversion to San Francisco and Oakland can be attributed to the high fare level between Santa Rosa and San Francisco, the necessity of changing planes and the ensuing layover required at San Francisco for long-haul flights, the greater choice of airline flight destinations and schedules available at San Francisco/Oakland, and the relative travel time (see Figure 1) and distance to Sonoma County Airport and San Francisco and Oakland airports.

This is a typical situation where a larger "nearby" airport has substantially greater airline service than a smaller airport. Present day examples of this phenomenon are: Hartford (Connecticut) and New York-LaGuardia (140 miles); Colorado Springs and Denver-Stapleton (65 miles); and Salem and Portland (40 miles).

GENERAL FORECAST ASSUMPTIONS

The aviation activity forecasts presented herein are based, in part, upon: past and present projected trends of the Sonoma County socioeconomic indices; past and projected trends in the aviation industry; and forecasts contained in the Regional Airport System Study, the California Master Plan of Aviation, Phase I, and FAA Terminal Forecasts, 1975-1985. Historical socioeconomic and air traffic activity data have been detailed earlier in this chapter.

The forecasts of aviation activity, as summarized in Table 13, are predicated on the following general assumptions:

1. The population projections as prepared by the California State Department of Finance are reasonably accurate.
2. The economic base of Sonoma County will continue to increase with the percentage of population employed realizing an increase as employment growth exceeds that of population.
3. Long-term increases in per capita income will augment the public's inclination to travel by air and to utilize general aviation aircraft for personal/pleasure and business purposes.
4. Adequate aviation facilities will be provided to accommodate future air travel.
5. The availability of fuel will not act as a constraint on the long-term growth of aviation activity.
6. Future changes in user costs will not significantly affect aviation growth.

Additional assumptions for individual forecast elements are discussed in the following sections.

ENPLANED PASSENGER FORECAST: NO NEW REGIONAL AIRPORT

This forecast, which could be called the high forecast, is based on the following assumptions:

1. Neither Hamilton Air Force Base nor Napa County Airport nor any other airport will be developed in the North Bay area for scheduled air carrier services.

2. The airlines serving Sonoma County Airport will be responsive (within the limits of corporate objectives) to the air transportation needs of the area served by the Airport.

Given these two assumptions, growth in enplaned passengers at Sonoma County Airport is forecast to exceed the national level through the forecast period.

ENPLANED PASSENGER FORECAST: HAMILTON OR NAPA DEVELOPED AS REGIONAL AIRPORT

This forecast, which could be called the low forecast, is based on the following assumptions:

1. Either Hamilton Air Force Base or Napa County Airport will be developed as a regional airport with air carrier service to Southern California and points north and east of Santa Rosa.

2. Hughes Airwest services at Sonoma County Airport are discontinued and transferred to the new regional airport (Hamilton or Napa).

3. STOL Air or some other operator continues to offer scheduled commuter service from Sonoma County Airport to San Francisco International Airport.

4. The new regional airport at Hamilton or Napa will not be developed before 1976..

In the event of these contingencies, enplaned passengers at Sonoma County Airport are forecast to grow at established rates until 1975 when a new regional airport is assumed to be operational. Enplaned passenger traffic is then forecast to experience a drop-off as a result of expected diversion to the new airport. After the immediate decline caused by the new airport, enplaned passengers are forecast to again experience growth but from a lower base and at a more moderate rate.

PASSENGER FORECAST COMPARISON

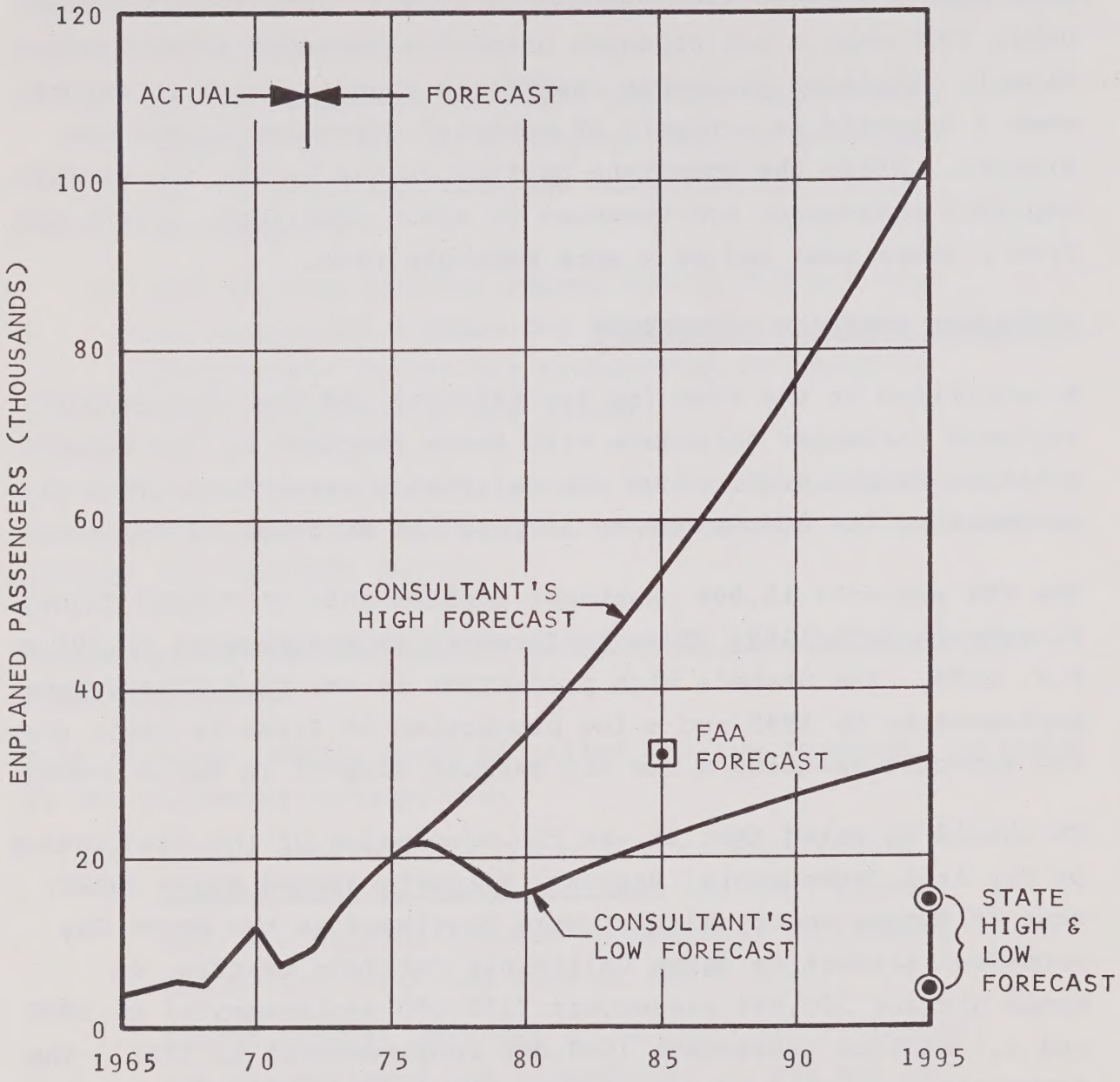
A comparison of the high (no new airport) and low (new airport) enplaned passenger forecasts with those prepared by the Federal Aviation Administration and the California State Department of Aeronautics for Sonoma County Airport can be found in Figure 7.

The FAA projects 12,000 passenger enplanements at Sonoma County Airport in F.Y. 1975. This is forecast to increase to 32,000 by F.Y. 1985. The State's high projection is for 14,315 passenger enplanements by 1995 and a low projection of 3,680 by 1995; the low forecast assuming a new air carrier airport in Marin County.

It should be noted that it was the conclusion of the Association of Bay Area Governments' Regional Airports System Study (RASS) that if Sonoma County Airport were developed as the North Bay counties' airport to serve California Corridor traffic, it would attract 300,000 passengers (150,000 enplanements) in 1975 and 1.1 million passengers (550,000 enplanements) in 1985. The forecasts presented herein do not assume the development of Sonoma County Airport as the North Bay counties' regional airport.

CARGO AND MAIL FORECAST

As discussed, historical cargo tonnages at Sonoma County Airport have not reached an order of magnitude which would have an impact



ENPLANED PASSENGER FORECASTS

NOTE: HIGH FORECASTS ASSUME NO NEW NORTH BAY AIRPORT

LOW FORECASTS ASSUME DEVELOPMENT OF NEW NORTH BAY AIRPORT.

FIGURE 7

on facility requirements. No factor was discovered in the socio-economic analysis which would change this condition; however, moderate cargo grwoth rates have been projected and are presented in Table 13. There is no evidence at the present time that the U.S. Postal Service will reverse its decision to handle Sonoma County mail by surface transportation rather than air.

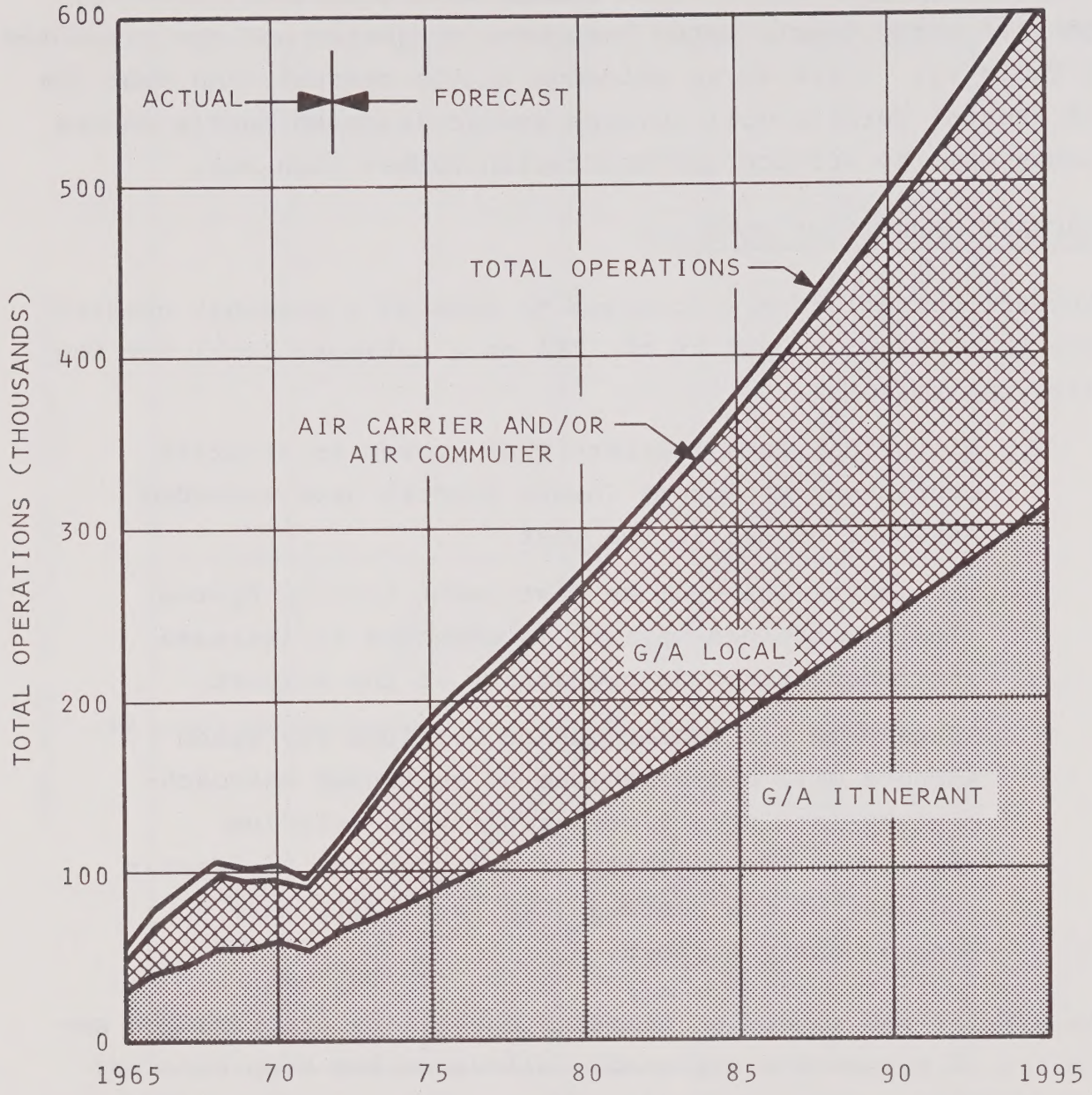
AIRCRAFT OPERATIONS FORECAST

Aircraft operations are forecast to grow at a somewhat greater rate than that forecast by the FAA on a national level for the following reasons:

1. Historical data indicate that growth in aircraft operations at Sonoma County Airport have exceeded national growth in the past.
2. The installation of an Instrument Landing System (ILS) in the near future is expected to increase instrument training operations at the Airport.
3. Santa Rosa Air Center and/or Petaluma Sky Ranch Airport will close because of continued encroachment by land uses incompatible with aviation activity. The majority of users at the Air Center and many of the users at Sky Ranch will move to Sonoma County Airport.

Air carrier and scheduled commuter operations are based on estimates of passengers enplaned. Allowance has been made for nonscheduled airline operations.

General aviation itinerant operations are based on national trends and the expected availability of first-class aviation facilities at Sonoma County Airport. General aviation local operations are related to the number of aircraft owners in the area and consideration of the ILS system planned for the Airport. Figure 8 presents the operations forecast graphically.



ANNUAL AIRCRAFT OPERATIONS FORECAST

FIGURE 8

By 1985, the Consultant's forecasts for general aviation activity exceeds that of the Federal Aviation Administration (Terminal Area Forecasts, 1975-1985) for Sonoma County Airport by nearly 90%. This is caused by two factors: (1) growth in based aircraft at Sonoma County Airport has greatly exceeded FAA estimates and (2) the Consultant has evaluated the proposed improvements to Sonoma County Airport along with the possible closure of neighboring airports to project expected demand at the Airport.

IFR-VFR FORECAST

Instrument operations and instrument approaches were projected to reflect the installation of the ILS and the expected increase in aircraft sophistication. The ILS will attract instrument training operations from many lesser equipped airports in the region. One particular source of additional instrument training activity is anticipated to be from Japan Air Lines practice activity at Napa County Airport. This attraction element is expected to contribute to an increase in total operations and lead a shift toward a higher percentage of Instrument Flight Rules (IFR) operations.

Another factor which will affect the level of instrument operations nationally is a change in FAA regulations which will require an instrument rating for all pilots seeking a commercial license.

It is expected that air carrier and/or commuter operations will continue to operate during periods of reduced visibility and ceiling and the ratio of IFR approaches to total landings will remain relatively constant. The same ratio for general aviation operations is expected to increase reflecting the growth in sophisticated general aviation aircraft and the greater propensity to fly during periods of inclement weather.

BASED AIRCRAFT FORECAST

Based aircraft forecasts are based on historical data and trends, the expected closure of two nearby airports, and projections of national and local general aviation activity growth. The majority of those aircraft currently based at the Santa Rosa Air Center and Petaluma Sky Ranch that are registered to residents of the Sonoma County General Aviation Air Trade Area are assumed to be relocated to Sonoma County Airport. Another assumption made for this forecast is that T-hangar availability will be increased to accommodate the demand. There are currently 95 aircraft at the Airport housed in hangars with a waiting list for approximately 40 additional hangar spaces.

EFFECT OF LOCAL GENERAL AVIATION AIRPORTS

In the event that Santa Rosa Air Center and/or Petaluma Sky Ranch Airport do not close, as was assumed in the foregoing forecasts, the operational and based aircraft levels summarized in Table 13 would not be reached during the time frames specified. The effect of both airports remaining open indefinitely would be to delay the attainment of forecast activity levels four to six years. Likewise, it was assumed that Sonoma Sky Park (or a new airport in that area) would remain open for aviation uses. If aviation facilities are denied that area, additional demand will be placed upon Sonoma County Airport, thus accelerating the forecast of general aviation activity.

Table 13

AVIATION FORECAST SUMMARY
Sonoma County Airport

	1974	1980	1985	1995
ENPLANED PASSENGERS				
High Forecast	25,012	35,100	54,300	102,000
Low Forecast	--	15,900	21,700	36,000
ENPLANED CARGO (Tons)	28.02	45	55	90
ENPLANED MAIL (Tons)	-0-	-0-	-0-	-0-
ANNUAL AIRCRAFT OPERATIONS				
Air Carrier and/or Commuter	7,346	8,800	10,800	13,500
General Aviation Local	58,915	132,000	179,400	294,000
General Aviation Itinerant	79,828	134,000	189,000	313,000
Military	918	1,000	1,000	1,000
Total Operations	147,007	275,800	380,200	621,500
VFR OPERATIONS	137,351	246,700	340,600	556,400
IFR OPERATIONS	9,656	29,100	39,600	65,100
INSTRUMENT APPROACHES	1,840	4,200	6,100	11,000
BASED AIRCRAFT	275 1/	435	550	780
BUSY HOUR OPERATIONS	70	135	180	270

1/ September 1975

VI - DEMAND/CAPACITY ANALYSIS

A capacity analysis of an airport such as Sonoma County Airport will reveal that each subsystem, e.g., aircraft landings, passenger processing, automobile arrivals and parking, etc., may be considered queuing operations. Each aircraft, passenger, or automobile involved in these processes is competing for a place in line in order to complete its desired function at the airport. Therefore, if two such airport users simultaneously conflict in their desire to utilize a particular facility, such as a runway, ticket counter, or access roadway, one must wait or queue until the other has completed its operation. It is this situation of waiting which forms the basis of the definition for capacity. Each subsystem must first be analyzed with respect to its capacity and then the relationships between subsystems are analyzed to determine the capacity of the airport as a whole.

AIRFIELD CAPACITY

Airfield capacity is defined as that level of annual or hourly operations at which delays to aircraft reach a maximum acceptable magnitude. Studies indicate that this acceptable delay will vary for different types of demand. Specifically, there are two types of demand for which different values have been determined: general aviation and air carrier aircraft. Indications are that on a normal basis, capacity has been reached when delays average two minutes for general aviation aircraft and four minutes for air carrier aircraft.

Factors Affecting Capacity of the Airfield

The various factors considered in the determination of the hourly and annual capacity of the existing runway configuration at Sonoma County Airport include:

- o Aircraft mix (percentage of each of the different types of aircraft using the facilities).
- o Airfield configuration: Orientation of runways and location of exit taxiways.
- o Runway use: Runway use may depend on:
  - wind velocity
  - air traffic controller preferences
  - pilot preferences
  - location of airfield destination (i.e., passenger terminal, general aviation area, etc.).
- o Terminal navigational aids.
- o Weather: Wind, visibility, and ceiling
- o Percentage of touch-and-go traffic.
- o Monthly, weekly, daily, and hourly variation in traffic demand.

Aircraft Mix: Based on a tower survey conducted by the Consultant and on historical records, it was determined that greater than 95% of the operations at Sonoma County Airport are by light, single- and twin-engine aircraft (Classes D and E in the Federal Aviation Administration capacity classification system).

Airfield Configuration: The existing facilities plan, Drawing 1, shows that the present airfield configuration consists of two intersecting runways: Runway 1-19 (5,000 feet) and Runway 14-32 (5,003 feet). These runways intersect at the thresholds of Runways 14 and 19.

Runway Use: Runway usage is dependent on wind conditions; however, presently calm wind operations include takeoffs on Runway 19 with landings on Runway 14. This is advantageous from a

capacity standpoint as aircraft are operating away from the intersection, thereby minimizing conflict. The installation of the Instrument Landing System (ILS) on Runway 32 will make this the favored runway for landings; however, Runways 14 and 19 will always be available for high volume, Visual Flight Rules (VFR) conditions.

Terminal Navigational Aids: The capacity of an airfield during periods of Instrument Flight Rules (IFR) weather conditions depends on the availability of on-site and/or remote approach instrumentation. Air traffic control procedures dictate different aircraft separation minimums based on the sophistication and location of different types of instrumentation.

Instrument approaches at Sonoma County Airport are presently made utilizing an Instrument Landing System (ILS) or a Very-High-Frequency-Omni-Directional-Range (VOR) facility located on the Airport. Aircraft equipped to take advantage of the ILS may make a straight-in approach to Runway 32 with ceilings as low as 250 feet and visibility as low as 3/4 mile. The VOR approach to Runway 32 is more restrictive than the ILS approach, requiring a minimum ceiling of 400 feet and visibility of at least one mile.

As mentioned in Chapter III, the approach lighting system associated with the ILS is being installed. When fully operational, the ILS approach is expected to have new minimums of 200 feet ceiling and 1/2 mile visibility. The approach course of the ILS is referred to as the front course approach. The localizer also transmits a signal oriented for approaches from the opposite runway end, i.e., approaches to Runway 14. This is known as the ILS back course (BC) approach. The ILS(BC) approach must be adjusted and tested for accuracy prior to receiving operational status approval from the FAA. The back course approach to Runway

14 at Sonoma County Airport is expected to receive FAA approval in the near future. When these improvements to Sonoma County Airport are completed, the IFR capacity of the Airport will be increased.

Traffic Operational Characteristics: A recent survey of airfield activity conducted by the Consultant indicates that 40% to 45% of the traffic at Sonoma County Airport is touch-and-go. A touch-and-go is a landing practice maneuver whereby a pilot touches down, slows to a controlled speed, and then accelerates to a takeoff without ever exiting the runway. The effect on capacity is that this maneuver is counted as two operations (one landing and one takeoff) while occupying the system only slightly longer than a regular takeoff or landing. The 40% to 45% touch-and-go activity may go as high as 60% during the peak hour.

The peaking factor (percent of average daily traffic occurring during the average of two consecutive peak hours) throughout the survey period was found to be approximately 16%. It was also determined from the survey that the ratio of arrivals to departures was within the 0.7 to 1.1 range, which the FAA capacity procedure considers typical for primarily general aviation airports.

Existing Airfield Capacity

The capacity of the existing runway system was evaluated using the FAA method described in "Airport Capacity Criteria Used in Preparing the National Airport Plan" (Advisory Circular 150/5060-1A), "Airport Capacity Criteria Used in Long-Range Planning" (AC 150/5060-3A), and the methodology described in the Airborne Instruments Laboratory, "Airport Capacity Handbook", second edition.

From these analyses, the capacity of the Airport was determined to be approximately 275,000 annual operations. The weighted hourly capacity is 150 VFR operations and approximately 40 IFR operations subsequent to the complete installation of the ILS. Wind conditions dictate the use of a single runway nearly 20% of the time which lowers the capacity to approximately 125 operations/hour.

Ultimate Airfield Capacity

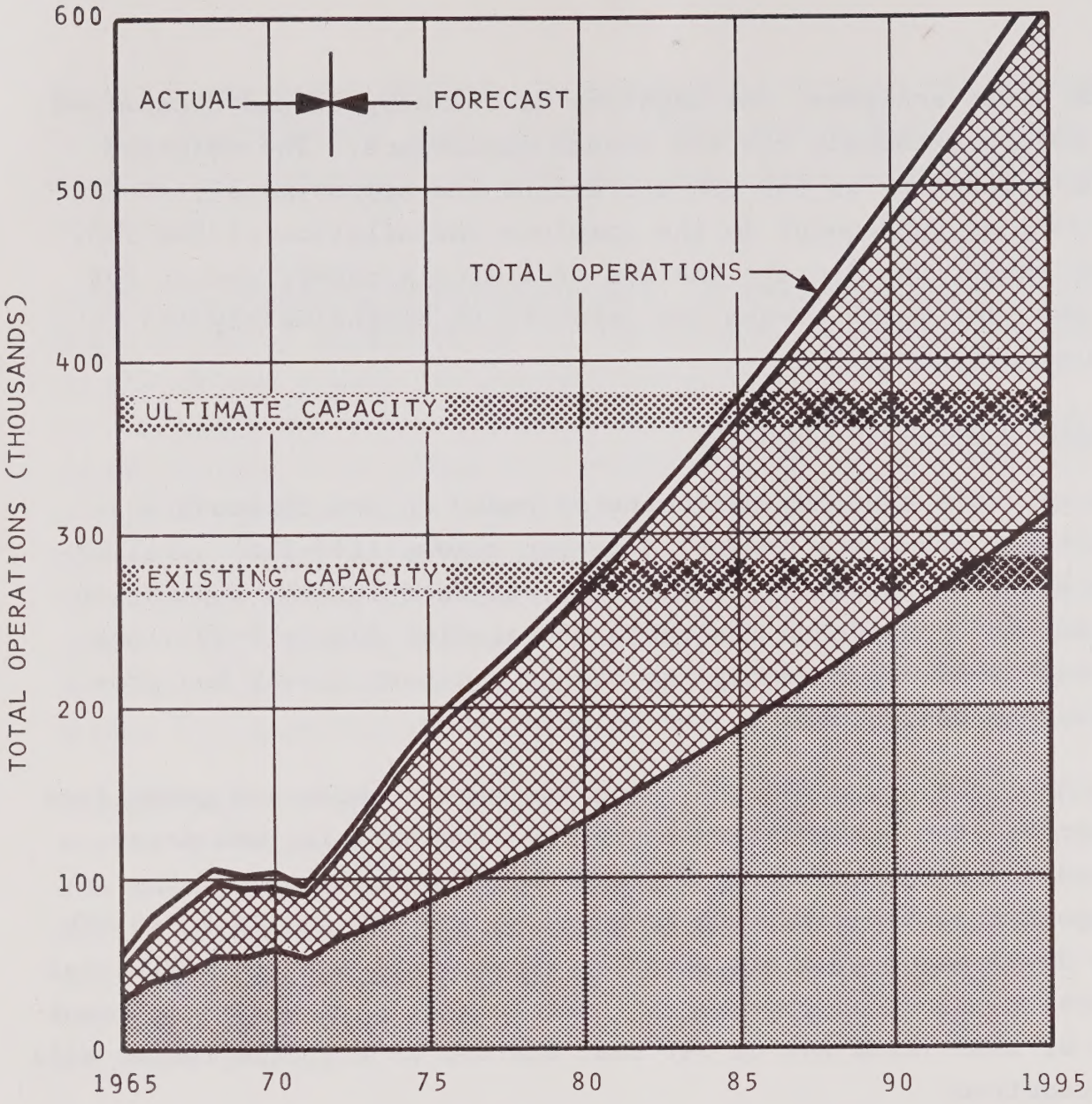
The ultimate capacity was computed based on the forecast aircraft mix and a new general aviation runway (14R-32L) paralleling existing Runway 14-32 with a 1,400-foot lateral separation. It was not considered desirable to parallel Runway 1-19 since Runway 14-32 is presently the highly dominant runway and provides the best access to the building area.

The analysis was conducted using the same methods and guidelines described for the existing capacity. The capacity was determined to be approximately 370,000 annual operations and the average hourly capacity will increase to 190 VFR and 36 to 40 IFR. The development of a new parallel runway will have an additional positive effect on capacity in that it will decrease the percentage of time (from 20% to 3%) that the use of a single runway will be required.

Annual demand capacity comparisons are presented graphically in Figure 9.

ROADWAY CAPACITY

The capacity of any given roadway segment is primarily a function of the number and width of traffic lanes and the number of access points (driveways, side streets) that exist. Existing peak-hour movements along with the capacity of roadways around Sonoma County Airport were analyzed to determine the present level of service. The "level of service" concept developed by



ANNUAL DEMAND CAPACITY COMPARISONS

LEGEND

- AIR CARRIER AND/OR AIR COMMUTER
- GENERAL AVIATION - ITINERANT
- GENERAL AVIATION - LOCAL

FIGURE 9

the Highway Research Board is a method to describe different operating conditions that may occur on a given traffic lane or roadway when it is carrying various traffic volumes. Six levels of service have been defined, ranging from "A" (free flow, low volumes, high speeds, little or no restrictions in maneuverability because of other vehicles) to "F" (forced flow operation at low speeds and frequent stoppages). Level of service "C" means stable flow, satisfactory operating speed, but drivers are restricted in their freedom to select their own speed, change lanes, or pass.

Existing access route volumes, capacity, and the resulting level of service for Sonoma County Airport are tabulated below. Neither of the existing access routes to the Sonoma County Airport presently experience volumes that approach their respective capacities. Airport Boulevard operates far below capacity even at peak traffic hours. Existing peak-hour traffic on Highway 101 approaches half of its capacity (46%); however, this is well below the level at which any congestion or delay will occur.

VOLUME TO CAPACITY RATIO
Sonoma County Airport Access Roadways

Roadway	Peak-Hour Volume	Capacity	Volume/ Capacity	Level of Service
U.S. Route 101	3,200	7,000	.46	A
Airport Boulevard (West of U.S. 101)	101	1,500	.07	A
Airport Boulevard (Near Terminal)	131	3,000	.04	A

AUTOMOBILE PARKING CAPACITY

There are ten distinguishable parking areas on Sonoma County Airport. By estimating the spaces available in the unmarked areas and combining them with the designated parking spaces, it appears that approximately 350 spaces are presently available for automobile parking. Approximately 85 spaces are available in the general aviation area south of the terminal, 50 spaces in the general aviation area north of the terminal, and 215 spaces in the terminal area itself.

During a four-month period, County personnel conducted random surveys of the number of vehicles parked at the Airport during typically busy periods. By averaging these inventories, it appears that the space utilization in the southern area was approximately 45%, the utilization north of the terminal was 75%, while in the terminal area itself it was 33%. The major terminal parking lot (132 spaces) was only used to 12% of its capacity.

As general aviation activity increases, there will be a requirement for additional parking both north and south of the terminal. It is expected that this requirement will be met by the use of "informal" parking areas which will accompany future development. A modification of the terminal parking lot will result in capacity to meet the requirements until the end of the forecast period, even considering that an expansion of the Terminal Building to the north would displace some of the present employee parking.

VII - FACILITY REQUIREMENTS

AIRFIELD REQUIREMENTS

Runways

There are essentially three conditions wherein additional runway construction, beyond normal maintenance procedures, is required:

1. Wind conditions at an airport may limit the use of existing runways;

2. Traffic volumes may exceed the capacity of the airfield; and/or

3. Existing runways may require lengthening or strengthening for use by larger aircraft.

The possibility of these conditions existing at Sonoma County Airport was examined to determine additional runway requirements. The results of these examinations are discussed below.

Wind Conditions: Wind has a substantial impact on the operation of an airport, in that pilots normally attempt to operate into the wind, thereby keeping their ground speed to a minimum. During landing, it is also desirable to keep the crosswind component (wind 90° to flight path) at a low velocity, thus requiring only a minimum of flight correction for wind during the final approach and landing.

Analysis of wind data is accomplished by a graphical-mathematical system called the wind rose. Utilizing data obtained by the U.S. Air Force during the period from April 1943 to December 1945 (the most recent tabulation available), a plot was made of the percentage of wind at various speeds coming from the 16 points of

the compass. From this plot, given the crosswind limitations of an aircraft, one can graphically determine the average percentage of time that operations can be conducted in a particular direction. The wind rose developed for Sonoma County Airport is shown on Drawing 4, Airport Layout Plan.

Crosswind limitations are a function of an aircraft's stall speed. For general planning purposes, crosswind limits of 15 knots (17.25 mph) for air carrier type aircraft and 10.5 knots (12 mph) for general aviation type aircraft under 12,500 pounds have been established. Although it is desirable to land into the wind, a four-knot (4.5 mph) tail wind is considered acceptable when estimating preferential runway usage except in cases of low ceiling or visibility. A pilot has the responsibility to make the final decision about the wind conditions in which he will land. His decision is usually dependent upon the aircraft's flight characteristics, airline policy, and his own proficiency.

Assuming the 10.5-knot general aviation crosswind criteria, the following wind coverages are afforded by the existing runways at Sonoma County Airport:

Runways 14-32	96.4%
Runways 1-19	91.1%
All Runways	98.1%

Federal Aviation Administration planning guidelines indicate that wind coverage above 95% obviates the need for an additional runway to improve wind coverage at an airport. As can be seen from the above figures, the orientation of the primary runway (14-32) provides adequate wind coverage with respect to planning guidelines.

Capacity Constraints: A comparison of forecast traffic volumes and the existing airfield capacity determined in Chapter VI indicates that capacity will be reached and average delays to aircraft will exceed acceptable values by 1980 (see Figure 9). The capacity analysis further indicates that the capacity of the airfield can be increased almost 40% with the addition of a parallel runway. The combination of better wind coverage, instrumentation on Runway 14-32, and shorter taxi distances indicate that the new runway should parallel Runway 14-32 rather than Runway 1-19.

Traffic volumes are expected to exceed the capacity of the parallel configuration around 1985. Although it would be technically possible to construct a third parallel runway to further increase capacity, it is the Consultant's recommendation that consideration be given instead to development at another site to meet capacity requirements beyond 1985. It is the Consultant's opinion that the requirements of the County's general aviation users will best be met by developing a general aviation airport south of the City of Santa Rosa.

Runway Length: The determination of required runway length is based on the flight characteristics of the "critical aircraft" which the runway is intended to serve. The thrust of the engines, the atmospheric conditions, the distance to the markets being served, and the amount of fuel required for the flight interrelate to determine the length of runway required for a takeoff at a desired payload (passengers and cargo).

During the preparation of this study, commercial operations at Sonoma County Airport were conducted by Fairchild F-27's and Britten Norman Islanders. The existing critical aircraft, however, does not come from the commercial fleet but rather from general aviation, represented by the Gulfstream II, a business jet aircraft. At 84°F., the mean maximum temperature at Sonoma County Airport, a

Gulfstream II can operate from a 5,000-foot runway with a full payload. There is not, therefore, an existing need to lengthen the runway. It should be recognized, however, that much of the demand by aircraft of this type occurs in periods when the temperature may significantly exceed 84°F.

The performance characteristics of the future "critical aircraft" for Sonoma County Airport will depend on several future policy decisions. The decision of the U.S. Forest Service to use DC-6's or C-119's for future fire fighting efforts, the decision by Hughes Airwest to reinstate service using DC-9 aircraft, the introduction of commuter service between Sonoma County Airport and Los Angeles using B-737's, and the possibility of increased use by advanced business jets such as the BAC-111 will all play an important role in determining future runway length requirements.

Figure 10 shows the payload/range characteristics of two commercial aircraft (DC-9-30 and B-737-200) that may be expected to operate from an airport like Sonoma County Airport. These characteristics were determined from FAA-approved flight manuals and the payload/range characteristics are shown for the existing runway as well as a 6,000-foot runway. It can be seen that under the conditions presented on the curves, the DC-9-30 has a range of about 500 nautical miles before incurring passenger restrictions, while the B-737-200 has immediate passenger penalties when operating from the existing runway. In Chapter IV it was determined that Southern California had a very high affinity for air travel with Sonoma County. A 6,000-foot runway would allow both aircraft to fly to Los Angeles with a near maximum passenger payload.

The landing field length requirements were studied for three aircraft which would have a high probability of use should air carrier service (other than existing commuter service) resume

PAYLOAD RANGE CURVES

SONOMA COUNTY AIRPORT

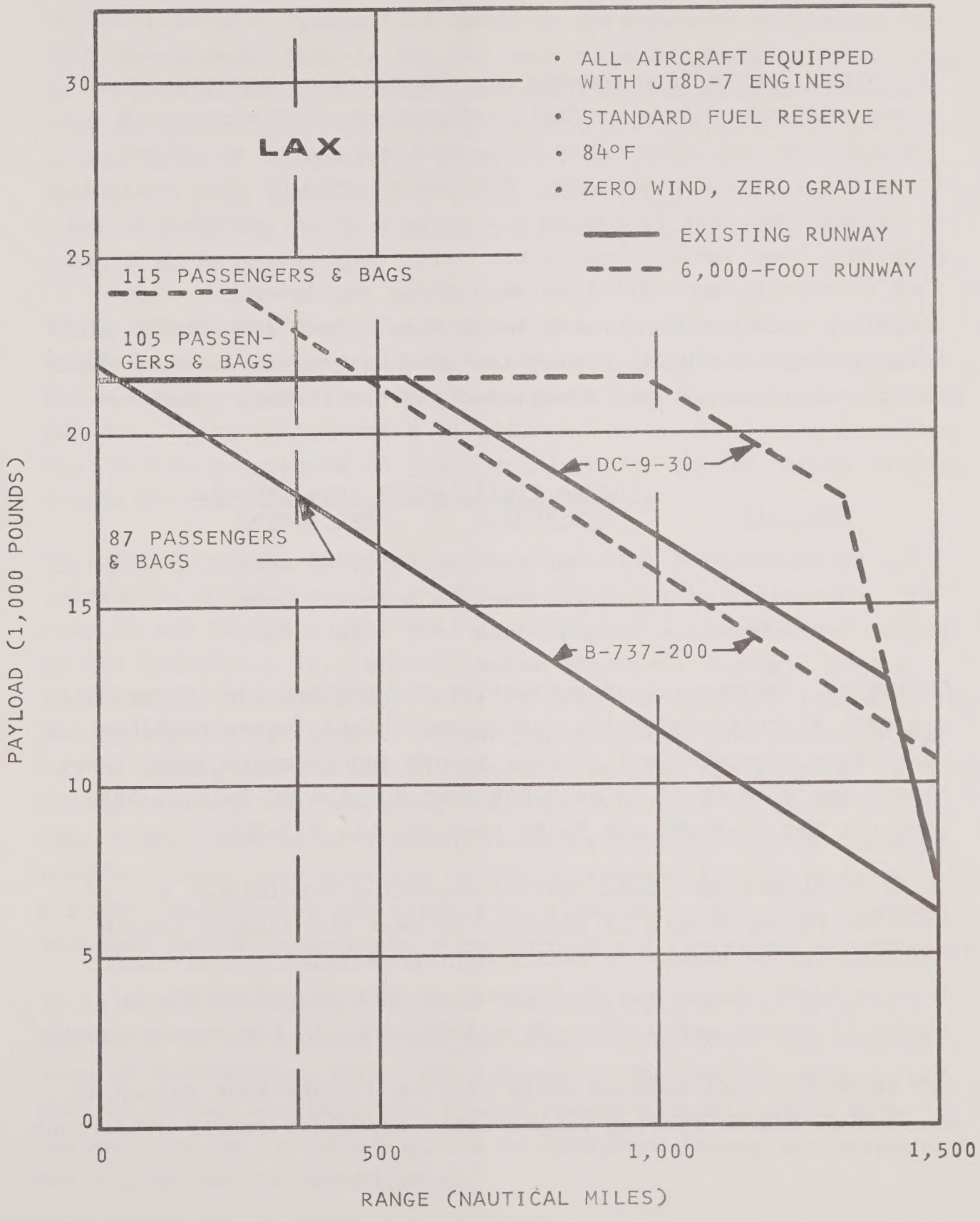


FIGURE 10

at Sonoma County Airport. The aircraft considered for this analysis were the DC-9-10 series, DC-9-30 series, and the 737-200 series.

The runway length requirements are dependent on landing weight, runway conditions (wet or dry), atmospheric conditions, and operation of such devices as anti-skid and engine air bleed for air conditioning systems. For the purpose of this analysis, a typical operating situation was assumed which included an 80% passenger load factor, negligible cargo, and enough reserve fuel to meet Federal Aviation Regulation requirements. Additionally, wind was considered to be zero knots, and runway gradient or slope was 0.0%. Using the above criteria, landing field length requirements were determined and the results tabulated below.

	Landing Field Length Requirements	
Aircraft	Dry Runway	Wet Runway
DC-9-10	4,500 feet	5,100 feet
DC-9-30	3,900 feet	4,600 feet
737-200	4,000 feet	4,600 feet

Operating characteristics reflecting the maximum landing weights for each aircraft under wet runway conditions (worst possible case) were also studied. Runway length requirements under these conditions were found to be 5,800 feet for the DC-9-10, 5,500 feet for the DC-9-30, and 5,100 feet for the 737-200.

It is concluded that under normal operating conditions, the existing runway length is adequate to meet the landing length requirements of short- to medium-haul commercial jet aircraft. Only on a wet runway and at landing weights significantly in excess of normal would there by a deficiency in the runway length.

All three aircraft studied could land on a 6,000-foot runway at maximum allowable landing weight under the worst runway conditions.

Based upon current FAA criteria, Sonoma County Airport would be eligible for a runway 6,000 feet in length. Additionally, the National Airport System Plan shows an extension to Runway 14-32 as a development item in the 0-5 year planning period. Therefore, it is recommended that long-range planning for airfield development at the Airport include a potential for a 6,000-foot ultimate runway length. Alternative airfield configurations for accommodating a runway extension to 6,000 feet (should the requirement arise) are presented in the Airfield Development Alternative section of this chapter.

It is recommended that the proposed parallel runway for general aviation aircraft be designed to Basic Utility Stage II standards which would accommodate 95% of the propeller aircraft under 12,500 pounds. Using FAA planning guidelines, it has been determined that a runway designed to these standards at Sonoma County Airport should be 3,200 feet long and 60 feet wide.

Pavement Strength: The maximum load bearing requirement on a repetitive basis for Runway 14L-32R, the taxiway system, and the ramp is now 54,000 pounds dual based on the maximum takeoff weight of the Gulfstream II. FAA estimates (Pavement Strength Survey, Form 5335-1, September 29, 1971) of pavement strength indicate that Runway 14L-32R is rated at 54,000 pounds dual. The taxiway parallel to Runway 14L-32R and the air carrier ramp are rated at 100,000 pounds dual and the remaining taxiways at 60,000 to 75,000 pounds. Therefore, there is no apparent need for a pavement strengthening program, based upon loadings of the Gulfstream II. As heavier aircraft begin using the Airport on a regular basis, the pavement strength should be accurately determined and increased if necessary.

It is important to remember that existing bearing strengths are estimates of the FAA based on the original thickness and composition of the subbase, base, and pavement. They do not necessarily reflect actual conditions at Sonoma County Airport, and a more refined testing procedure should be conducted before any strengthening programs are established.

It is recommended that any possible strengthening program for Runway 14L-32R and the east-west taxiways be designed to bring the bearing strength up to the 100,000 pounds dual range, which is the typical weight of the B-737, the DC-9, DC-6, and BAC-111. Consideration should also be given to coordinating this program with any future maintenance overlays if it can be established as cost effective.

Taxiways

An analysis of the existing taxiway configuration indicates that existing access to and from Runway 14-32 is adequate. The ultimate development of general aviation facilities will require consideration for circulation taxiways, the location of which will be determined by the specific alignment of the general aviation facilities within the land areas discussed later in this chapter.

The taxiway support configuration for Runway 1-19, a single exit located 550 feet from the southerly end of the runway, is not adequate. This runway receives the lowest exit rating possible under FAA capacity criteria, a factor which drops the expected capacity to 75 operations per hour from the single runway optimum of 110. In addition to the negative effect on capacity, the taxiway deficiency is costly to Runway 19 users in that approximately 90% of the existing mix is capable of touching down and making a right angle turn within 2,200 feet of the threshold. Under existing conditions, however, aircraft must taxi an additional 2,250 feet to Taxiway D and then return to the terminal area; this can account for up to one additional mile of taxiing for each landing.

It is recognized that, based on the wind analysis, the use of Runway 19 is not required a high percentage of the time and, because of the configuration of the Airport, Runway 1 is virtually

never used. However, there are "down times" for Runway 14-32 when Runway 1-19 must serve as the primary runway. During these down times and those times that Runway 1-19 is required for wind coverage, the existing taxiway configuration is very inconvenient and costly in terms of fuel and time consumed.

It is recommended that when the new parallel runway is constructed, additional taxiway access be provided for Runway 1-19. This recommendation is incorporated in all the positive action alternatives relating to the parallel runway presented later in this chapter.

Clear Zones

The clear zone is a trapezoidal area at the approach end of each runway which has been designated as obstacle free by the Federal Aviation Administration for operational safety purposes. The dimensions of these areas are determined by the type of approach. i.e., precision instrument, nonprecision instrument, or visual, and the runway classification, i.e., utility or transport.

Based on an analysis of the ultimate foreseeable approach procedures and expected runway usage at Sonoma County Airport, the following clear zones are required to meet FAA standards:

RUNWAY			CLEAR ZONE		
Numbers	Approach	Classification	Length	Inner Width	Outer Width
32R	Precision	Transport	2,500	1,000	1,750
14L	Nonprecision	Transport	1,700	1,000	1,510
1-19	Visual	Transport	1,000	500	700
14R-32L	Visual	Utility	1,000	250	450

The required clear zones for Runways 1-19 (at its present length) and 14R-32L are contained within existing airport property, whereas both clear zones for Runway 14L-32R extend beyond the existing property lines.

The purchase of a land area, larger than and encompassing the clear zone, is presently considered eligible for Federal funding and is recommended by the Consultant. The dimensions of this area for a runway serving turbojet aircraft, such as Runway 14-32 at Sonoma County Airport, are 1,250 feet to either side of the centerline and 5,000 feet out from the end of the primary surface for each runway end (the primary surface ends 200 feet from the runway threshold). The purchase of this amount of land was established as eligible for funding specifically to insure continued land use compatibility in the areas most directly affected by aircraft operations. The purchase of these areas at each end of Runway 14L-32R at Sonoma County Airport would serve a threefold purpose: protect the clear zones, assure compatible land use development beyond the clear zones, and provide future flexibility for presently unforeseen runway extension requirements. It is possible that Runway 1-19 may become a primary departure runway for heavier jet aircraft. In this event, a similar acquisition program to that described above will be eligible off the ends of this runway.

Landing Aid Requirements

Existing approach aids to Sonoma County Airport include a Very-High-Frequency-Omnidirectional-Range (VOR) and a full Instrument Landing System (ILS). Using these facilities, properly equipped aircraft may approach Runway 32 when the ceiling is as low as 200 feet and the visibility is as low as 1/2 a mile. These are the best minimums that can be achieved for a Category I approach. No information was available as to the percentage of time that weather conditions fall below these minimums; however, based on expected activity levels, the installation of additional landing aids for the purpose of lowering the operational minimums would not prove cost effective.

A landing aid that does little to increase airport capacity but significantly aids a pilot in making a noninstrument approach is the Visual Approach Slope Indicator (VASI). The present level

of Visual Flight Rules (VFR) itinerant operations at Sonoma County Airport will justify the implementation of a VASI system. It is recommended that a VASI system be installed on the approach ends of existing Runways 14 and 32. The installation of the VASI system will complement the Runway End Identifier Lights (REIL) in providing approach assistance to Runway 14. The REIL's for Runway 32 will be removed upon completion of the ILS. Even though Runway 32 will have a full ILS, it is recommended that a VASI system be installed as a landing aid for the large numbers of aircraft that will not be able to monitor the ILS.

AIRFIELD DEVELOPMENT ALTERNATIVES

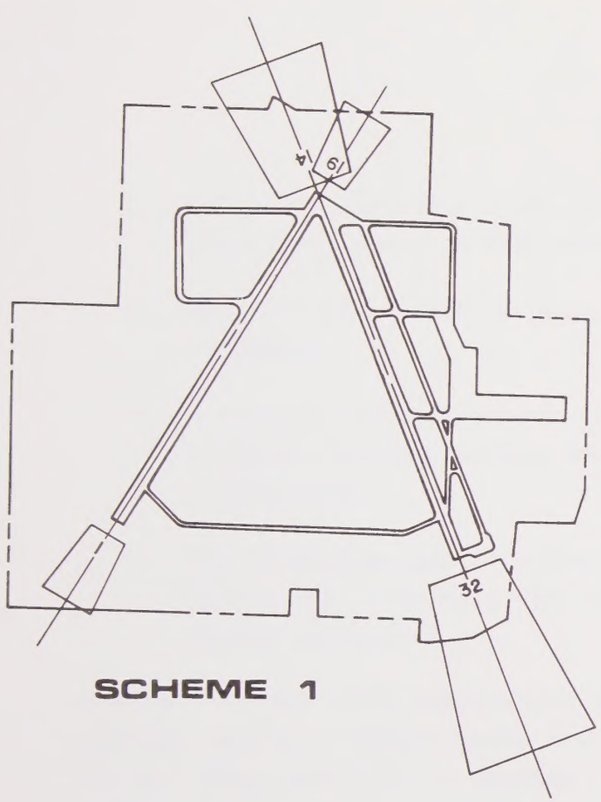
The foregoing analysis established the need for a general aviation runway parallel to Runway 14-32 and an additional exit taxiway for Runway 1-19. An analysis of available land, terrain conditions, and separation standards has established five alternatives for providing these airfield improvements. The analysis further indicates the potential need for a 6,000-foot runway at Sonoma County Airport and five alternatives were studied with respect to meeting this potential need.

Parallel Runway and Exit Taxiway Alternatives

As illustrated schematically on Drawing 3, all alternatives except the null alternative involve the location of a 3,200-foot parallel runway located 700 to 1,400 feet west of Runway 14-32. All runways are located on airport property, with the differences between the feasible alternatives being separation distances and threshold locations.

The following factors were considered pertinent in the selection and recommendation of a specific development program.

1. Separation between the parallel runways should be maximized to increase safety margins.



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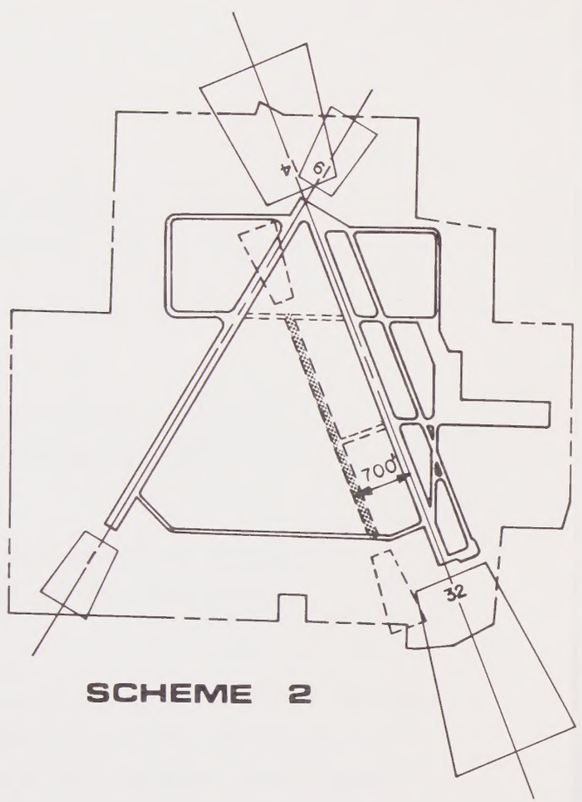

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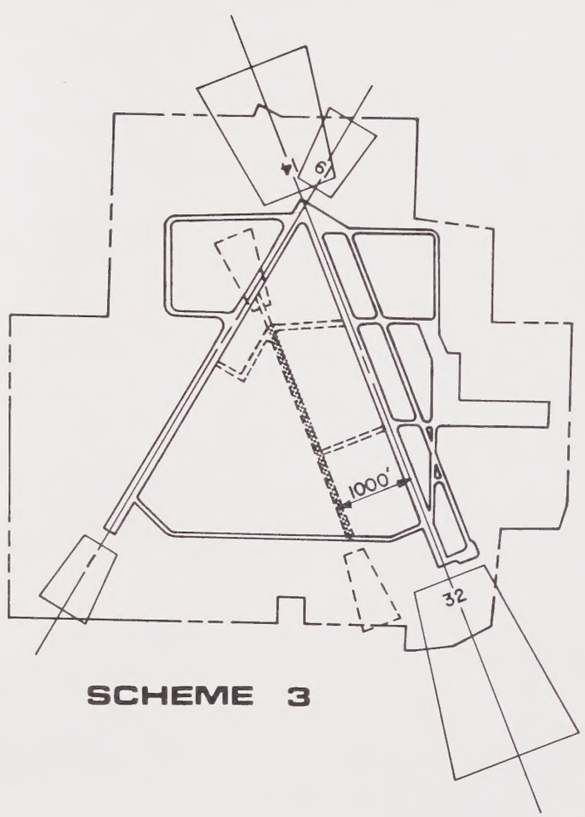

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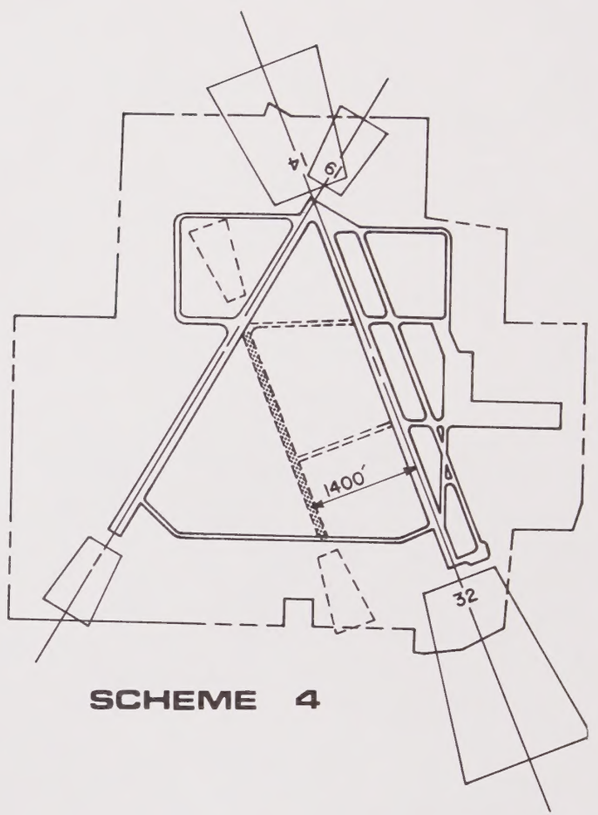

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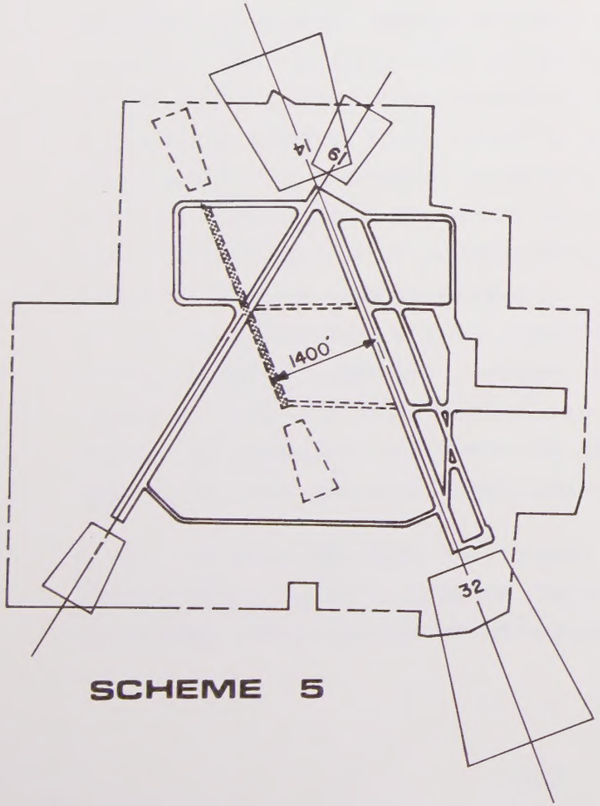

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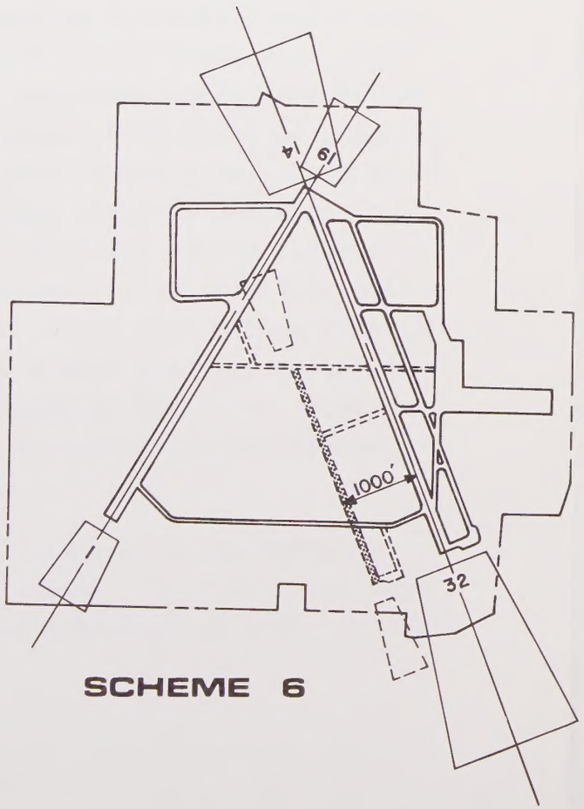
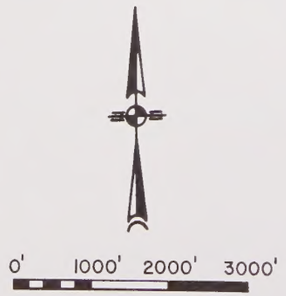


SCHEME 6



LEGEND

PROPOSED RUNWAY 14R-32L, LENGTH - 3200'

PROPOSED TAXIWAY

EXISTING PROPERTY LINE

THE PREPARATION OF THIS DOCUMENT WAS FINANCED IN PART THROUGH AN AIRPORT MASTER PLANNING GRANT FROM THE DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, UNDER PROVISIONS OF THE AIRPORT AND AIRWAY DEVELOPMENT ACT OF 1970, AS AMENDED.

SONOMA COUNTY AIRPORT

SANTA ROSA, CALIFORNIA

ALTERNATIVE PARALLEL RUNWAY LOCATIONS

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

3

2. Aircraft operating on a runway should not be required to cross another potentially active runway.

3. Maximum use should be made of existing taxiway alignment.

4. Confusing taxiway/runway intersections should be avoided; taxiway access should be direct and uncomplicated.

5. The alignment and location of the proposed runway should not eliminate the potential for its future runway extension.

Scheme 1 is the null alternative where nothing is done to satisfy general aviation demand above the capacity of the existing airfield. When capacity is reached, users will either begin operating from another airfield, discontinue flying, or continue to operate at Sonoma County Airport accepting increasing delay penalties. The construction of an airport in the Santa Rosa area which would afford approximately the same additional capacity as a parallel runway would require a minimum of 80 acres of property along with the necessary aviation support facilities. This would involve substantial duplication, because property and support facilities capable of accommodating a parallel runway already exist at Sonoma County Airport. If no relief is provided, delays of 10 to 15 minutes may be expected in times when demand substantially exceeds capacity. Since these delays are very costly in terms of time and fuel wasted, an airport operating at levels above its capacity would not be very attractive to businesses that rely upon aviation services.

It is recommended that the County not allow aviation demand to exceed the Airport's present capacity level. This goal can best be accomplished by the construction of a general aviation runway

parallel to Runway 14-32. Alternatives for locating a runway of this type are discussed in the following text.

The 700-foot runway separation between parallel runways in Scheme 2 is the least of the five alternatives and is considered the chief drawback to the scheme. Although the closer separation would decrease the distance between the building area and the runway, the increasing concern in the general aviation community regarding wake turbulance makes such a minimum separation undesirable.

Scheme 3 reflects a 1,000-foot lateral separation between runways. The taxiway/runway intersection at the north end of the proposed runway is more complicated; however, location of the exits for Runway 1-19 are improved relative to Scheme 2.

Scheme 4 separates the parallel runways by 1,400 feet, twice the minimum required by the Federal Aviation Administration. The intersection of the proposed runway, the cross-field taxiway, and Runway 1-19 is such that approximately 75% of the landing aircraft could exit Runway 1-19 at that point. This scheme would require, as would all other schemes except Scheme 5, that a section of the remaining military hardstand pavement at the south end of the proposed runway be removed. This would be necessary to facilitate the visual identification of the runway end.

Schemes 5 and 6 locate the parallel runway 1,400 feet and 1,000 feet, respectively west of existing Runway 14-32. Scheme 5 approximately aligns the thresholds for Runways 14R and 14L, whereas Scheme 6 aligns the thresholds for Runways 32R and 32L. Either of these schemes would provide visually distinct approach ends, less complicated for incoming pilots. Disadvantages to Scheme 5 are the excessive taxi distances required to depart from Runway 14R or land on Runway 32L. Additionally, it is not

considered desirable to create the potential intersectional conflicts between operations on Runways 14R and 19. Scheme 6 would require longer taxi distances for arrivals on Runway 14R and departures on Runway 32L.

From the foregoing analysis, it is the Consultant's recommendation that Sonoma County construct a 3,200-foot general aviation runway parallel to, and 1,400 feet west of Runway 14-32. This program, presented as Scheme 4, also involves the construction of two cross-field taxiways to provide access to the proposed runway. One taxiway, an extension of existing Taxiway C, would intersect near the middle of the new runway and the other new taxiway, a westerly extension of Taxiway B, would intersect the proposed Runway 14R-32L and Runway 1-19 at the same point, providing a much needed exit for Runway 1-19. As discussed, this program would also require the removal of some existing pavement at the south end of the proposed runway.

Runway Extension Alternatives

Five alternatives relating to the possible requirement for additional runway length at Sonoma County Airport are discussed in the following section. This discussion is intended to present the County with the major advantages and disadvantages of various runway extensions at the Airport. At such time as detailed analysis of this issue becomes necessary, the following comparisons will provide a good study base. The alternatives evaluated were:

1. No extension.

2. Extend Runway 14-32 1,000 feet to the north.

3. Extend Runway 14-32 1,000 feet to the south.

4. Extend Runway 14-32 500 feet to the north and 500 feet to the south.

5. Extend Runway 1-19 1,000 feet to the south.

The advantages to the null alternative are related to capital costs and minimal environmental impacts. The construction and land acquisition costs, as well as the environmental impacts associated with this alternative are less than those of Alternatives 2 through 5. The existing 5,000-foot runway is capable of safely accommodating a majority of the aircraft demand which can be expected through the forecast period.

There will, however, be times when aircraft will not be able to depart from a 5,000-foot runway (14-32) due to combinations of high aircraft weight and air temperature. This will require either a payload/range reduction or a delay until the temperature declines. Either of these options will result in economic and convenience penalties to airport users, particularly those associated with the aerial fire fighting effort at Sonoma County Airport.

Alternatives 2 through 4 reflect a 1,000-foot extension to Runway 14-32. These alternatives are different with respect to the placement of the extension north, south, or at both ends of the existing runway. Alternative 5 considers a possible extension to Runway 1-19. A comparison of the advantages and disadvantages associated with each alternative must include the direct effects of the proposed construction and the indirect effects of location changes of the clear zone, threshold, and aircraft flight paths.

These four "action" alternatives have several common effects which were studied and compared to the null alternative. All three will provide 6,000 feet of runway length which, with only minimal payload/range restrictions, will accommodate the potential "critical aircraft" discussed in the runway length section of this chapter. All of these alternatives have the additional advantage of increasing operational and safety margins for aircraft presently operating at the Airport.

The common disadvantages to Alternatives 2 through 4 are cost related. All three will require 1,000 feet of air carrier standard runway and taxiway. Each will require the construction of a holding apron at the end of the extended runway and the purchase of additional acreage for clear zone and land use compatibility zone requirements. To keep the following discussion of cost differentials in a proper perspective, it must be pointed out that the common cost of a 1,000-foot extension (excluding land) is estimated to be $750,000±.

There are at least five areas of consideration wherein the positive and negative considerations for Alternatives 2 through 4 are distinctly different: land fill, pavement, navigational aids, utilities, and environmental impact.

A 1,000-foot extension to the north end of Runway 14-32 (Alternative 2) would require an estimated 400,000 to 500,000 cubic yards of fill to meet horizontal and longitudinal runway grade requirements. An estimated 100,000 cubic yards would be required for an extension to the south (Alternative 3), and approximately 150,000 cubic yards of fill would be necessary to split the extension 500 feet on both ends (Alternative 4). These "differences" can be translated into a cost penalty of $250,000 to $400,000 for extending the runway to the north.

In addition to the 1,000-foot air carrier taxiway and holding apron common to the three alternatives, an additional 400 to 500 feet of taxiway ($40,000±) will be required at the north end for a northerly or split extension to improve the existing angled access. A decision to split the extension, 500 feet on each end of the runway, will result in the requirement for the construction of two holding aprons, a cost penalty of $40,000± over Alternatives 2 and 3, which require only one new apron.

A relocation of navigational aids associated with the Instrumentt Landing System would be required for any of the three alternatives

discussed herein. An extension to the north will require the relocation of the localizer at an estimated cost of $20,000, whereas a southerly or split extension will require the relocation of the glide slope transmitter and much of the approach lighting system, at a cost of nearly $50,000.

Construction to the south (Alternatives 3 and 4) will require crossing an existing water line approximately 300 feet south of the existing threshold and either the relocation or closure of Laughlin Road. The costs associated with these measures will require further study and a determination of the exact procedures to be utilized. Preliminary estimates, however, indicate that the costs of crossing the water line and dealing with Laughlin Road are significantly less than those associated with the land fill requirements addressed previously.

The environmental impacts of Alternatives 2 through 4 were also reviewed to determine the optimum alternative from an overall system standpoint. The density of residential development is somewhat greater to the north of the Airport than to the south. Moving the runway threshold 1,000 feet to the north will lower the flight path for aircraft arrivals on Runway 14 and increase the noise impact of aircraft over north approach, implying an adverse impact to a greater number of homes. An extension to the south of either 500 feet or 1,000 feet will lower the approach surface over Mark West Creek, requiring increased trimming of the trees following the creek bed. However, an extension to the south would have a positive effect upon residents north of the Airport in that it would allow aircraft departing on Runway 32 to be at a higher altitude when passing over this area.

Alternative 5 considers the possibility of providing additional runway length by extending Runway 1-19. On the surface, the poor location of this runway with respect to the terminal area,

plus the fact that it is not the primary runway, makes this alternative appear very unattractive. However, under certain circumstances, this program may provide a very cost effective and environmentally advantageous solution to meeting future demands.

Due to terrain considerations, only a southerly extension of Runway 1-19 exhibits cost advantages over extending Runway 14-32. Because of residential developments northeast of the Airport, as well as the long taxi distance (8,000 feet) to the south end of Runway 1-19, aircraft departures to the north would not be anticipated. Since the additional runway length is only necessary for takeoffs of heavy aircraft on hot days, it can be expected that a very small percentage of the total airport users will require the improvement. A detailed meteorological analysis would indicate the merit of this alternative by determining the percentage of time that critical aircraft could depart on extended Runway 19.

A 1,000-foot southerly extension of Runway 1-19 (if proven feasible) may have significant cost advantages in that the additional pavement could be designated as a "stopway" and not be constructed to full load-bearing strength. Since no aircraft would be departing to the north, there is no requirement for taxiways associated with this extension. The terrain to the south of the runway is rather flat, thus reducing site preparation costs. This program would not affect Mark West Creek or Laughlin Road; however, a water line would have to be crossed and the clear zone extended 1,000 feet beyond airport property. It is anticipated that the only significant environmental impact of this alternative would be an increase in the noise exposure beneath the sparsely populated departure path of Runway 1.

The reference to a "stopway" in Alternative 5 is made only because Runway 1-19 is expected to be used infrequently. Since

Runway 14-32 is the primary runway, any possible extension to it should be full-strength in order to afford users maximum flexibility.

With respect to additional runway length requirements, it is the Consultant's recommendation that the demand for additional length be closely monitored and, at a time when demand becomes more apparent, an in-depth study be undertaken to determine the best course of action. *Detailed* analysis of user requirements, engineering and cost parameters, and the various environmental impacts should be evaluated at that time.

SUMMARY OF AIRFIELD REQUIREMENTS AND RECOMMENDATIONS

The most immediate airfield requirement is the need for a general aviation runway parallel to Runway 14-32. It is recommended that this runway be located 1,400 feet west of Runway 14-32 and that it be designed to the following criteria: length, 3,200 feet; width, 60 feet; and strength, 12,500 pounds single-wheel gear configuration. Two new general aviation taxiways should be constructed for this runway. It is recommended that the strength of Runway 14-32 be accurately determined and any deficiencies be remedied by a strengthening program. Rectangular areas (5,200 feet by 2,500 feet) centered off the ends of Runway 14-32 and Runway 1-19 should be purchased to insure approach protection, land use compatibility, and future flexibility.

No physical programs need be implemented in the near future with respect to a runway extension. The situation should be closely monitored and if a condition develops where additional runway length may be required, a detailed study should be conducted at that time. No actions, either on or off the Airport, should be permitted which would restrict the development of any of the runway length alternatives discussed in this report.

Drawing 4, in Chapter VIII, graphically displays these airfield recommendations. A southerly extension to Runway 1-19 is shown on the plan only for graphical reasons and does not represent a recommendation by the Consultant. If future studies substantiate the need for an extension and determine its optimum location, appropriate alterations should be made to the plan.

TERMINAL AREA FORECASTS AND FACILITY REQUIREMENTS

The terminal area requirements were reviewed with respect to existing and forecast demand on these facilities. Because of the high level of general aviation activity within the County, the potential of providing terminal facilities to serve the general aviation community, as well as commercial operations, was examined.

From field investigations, it is evident that the fixed base operators presently operating at the Airport are providing adequate service to the general aviation users. However, as the aircraft mix becomes more sophisticated in the future, i.e., as corporate jet activity increases, the County may decide to provide additional public facilities, i.e., a general aviation terminal, to meet the requirements of these airport users. The decision to provide these services would be a policy decision of the County based on the continued level of service provided by the fixed base operators.

Many of the requirements for terminal facilities are dependent upon total passenger activity, whereas others, such as airline check-in facilities or baggage claim facilities, are related to either the enplaning or deplaning peak-hour passenger volumes.

Based upon the forecast of annual enplaned passengers, a study of commercial schedules at Sonoma County Airport, and the Consultant's experience at similar airports, an estimate was made of average peak-hour enplaning passenger volumes.

As discussed in Chapter V, future passenger volumes are highly dependent on the role which Sonoma County Airport plays in providing air carrier service to the North Bay Area. The forecasts of terminal facility requirements presented herein were developed using the "high" passenger forecast, which was based on the following two assumptions:

1. Neither Hamilton Air Force Base nor Napa County Airport will be developed as air carrier airports during the forecast period.

2. Sonoma County Airport will not be established as a North Bay Regional Airport during the forecast period.

Should Sonoma County Airport experience commercial passenger diversions resulting from the development of Hamilton Air Force Base or Napa County Airport, it should be remembered that the facility requirements outlined are based on passenger volumes rather than specific points in time. Therefore, the requirements forecasts will remain valid when related to actual passenger volumes, irrespective of the year involved.

The development of Sonoma County Airport as the North Bay Regional Airport would require extensive additional terminal planning. It is possible that modification of the existing terminal would not be feasible and an investigation of alternative terminal sites would be required.

Therefore, based on the two assumptions outlined above, the level of future requirements for terminal floor area, aircraft parking positions, and automobile parking spaces is presented in Table 14. The recommended program to meet these requirements is discussed as a section of Chapter VIII, Airport Master Plan.

Table 14

SUMMARY

TERMINAL BUILDING FACILITY REQUIREMENTS

Sonoma County Airport

	1974	1980	1985	1995
ENPLANED PASSENGERS	25,012	35,100	54,300	101,800
TYPICAL PEAK-HOUR PASSENGERS	30	90	120	200
TYPICAL PEAK-HOUR ENPLANED OR DEPLANED PASSENGERS	20	65	85	140
AIRCRAFT PARKING POSITIONS	3	3	3	4
AUTOMOBILE PARKING SPACES[1/]	40	55	90	250
FLOOR AREA (square feet)				
Airline (Offices, Ticketing, Cargo)	1,150	2,900	3,600	4,000
Public (Lobby, Ticket Lobby, Circulation, Rest Rooms)	1,380	3,400	4,200	4,500
Concessions (Restaurant, Telephone, Vending)	2,500	3,900	5,100	6,000
Offices (Management, Rentals)	560	1,950	2,300	2,500
Total Floor Area[2/]	5,590	12,150	15,200	17,000
GENERAL AVIATION TERMINAL (square feet)	--	4,000	6,500	10,000

1/ 132 public spaces available in 1974.

2/ 5,600 square feet available in 1974.

GENERAL AVIATION FACILITY REQUIREMENTS

The facilities required by general aviation users, in addition to the terminal area discussed in the preceding section, include protective aircraft storage such as T-hangars, permanent tie-down spaces, transient tie-down spaces, and facilities for fixed base operators. The levels of future requirements with the exception of fixed base facilities, were forecast based on FAA planning guidelines, the existing demand, and the Consultant's forecast of based aircraft and general aviation operations. These levels are presented in the following tabulation. Requirements for fixed base operators cannot be forecast as they are dependent on decisions within the private sector and are a function of the type of services to be offered.

GENERAL AVIATION FACILITY REQUIREMENTS
Sonoma County Airport

	Tie-Down Areas					
	Based Aircraft		Transient Aircraft		T-Hangars	
Year	Number	Sq. Yds.	Number	Sq. Yds.	Number	Sq. Yds.
1974	130	38,000	50	17,700	135	119,000
1980	210	60,000	85	30,200	215	190,000
1985	*275*	*80,000*	*120*	*42,800*	*275*	*242,000*
1995	380	110,000	200	70,600	390	343,000

An analysis of the airfield configuration reveals that approximately 385,000 square yards are available for general aviation development east of Runway 14-32, south of Taxiway A, and north of the threshold for Runway 32, without violating the building restriction or parking limit lines. This available area can be compared to the gross land area required in 1985, when it is expected that the ultimate operational capacity of the airfield will be reached. This comparison indicated that the available land area is approximately equal to that required to meet the ultimate demand. The recommended configuration for future general aviation facility development is discussed in the on-airport land use section of Chapter VIII.

VIII - AIRPORT MASTER PLAN

AIRPORT LAYOUT PLAN

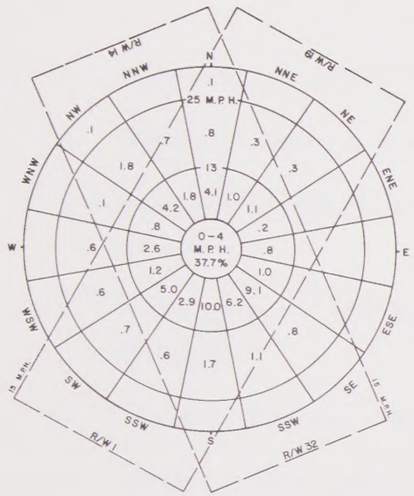
The proposed Airport Layout Plan (ALP) for Sonoma County Airport is shown in Drawing 4. This plan is essentially a graphical representation of the results of the studies and analyses discussed in Chapter VII, Facility Requirements. This plan is designed to meet the requirements established by the Federal Aviation Administration in Advisory Circular 150/5070-6, "Airport Master Plans", and was developed using current FAA standards applicable to the forecast aviation activity at Sonoma County Airport. In support of the airport layout, a Runway Data Table, Airport Data Table, Building and Facility Legend, All-Weather Wind Rose, and a Location Map are displayed on Drawing 4. The major recommended improvements and their priorities are presented in the following section on staging.

STAGING PROGRAM

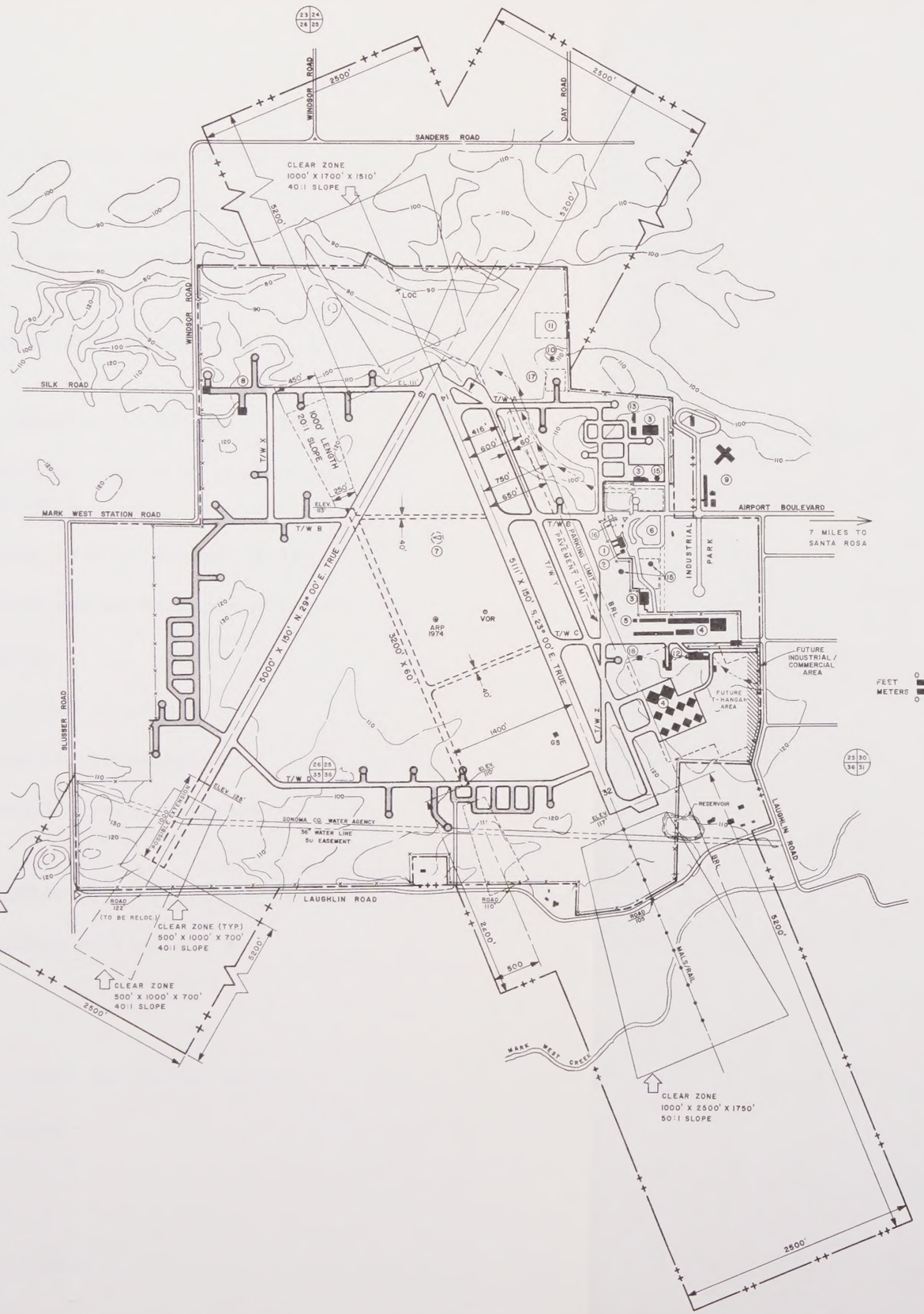
Airfield and terminal development programs are planned to occur in three time periods; Short-range (1975-1979), Intermediate-range (1980-1984), and Long-range development (beyond 1984). It should be emphasized that *staging of airport development is directly related to aircraft and passenger activity levels, irrespective of the particular year in which the level is attained, be it prior, or subsequent to the forecast year.*

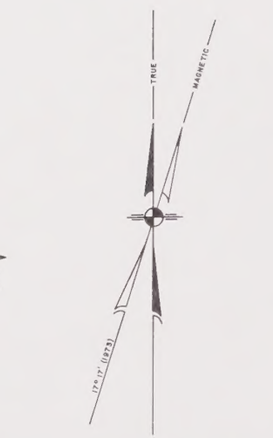
Short-Range (1975-1979)

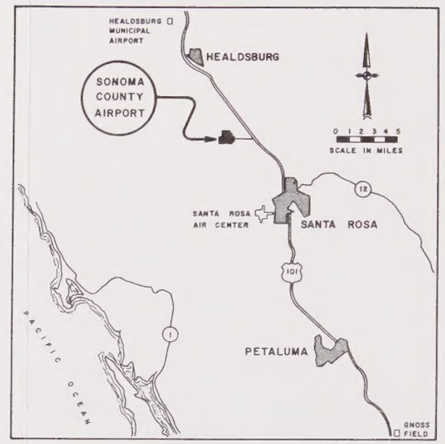
- Conduct pavement tests and strengthen Runway 14-32 and associated taxiways, if required.
- Construct new general aviation runway parallel to Runway 14-32.
- Determine feasibility of providing additional runway length at the Airport.



SOURCE: U.S. AIR FORCE PERIOD: APR. 1943 – DEC. 1945
OBSERVATIONS: 23,718
WIND COVERAGE WITH 15 M.P.H. CROSSWIND COMPONENT:
RUNWAY 14-32 97.3%
RUNWAY 1-19 96.2%
BOTH RUNWAYS 99.5%
NOTE: NO LOW VISIBILITY WIND DATA AVAILABLE







LOCATION MAP

AIRPORT DATA

		EXISTING	ULTIMATE
AIRPORT REFERENCE POINT	LAT.	38° 30' 32"N	38° 30' 32"N
	LONG.	122° 48' 42"W	122° 48' 38"W
AIRPORT ELEVATION		125' MSL	SAME
MEAN MAX. TEMP. HOTTEST MONTH		84°F	SAME
NAVIGATIONAL AIDS		VOR, RADAR*	SAME

* NOTE: LIMITED RADAR GUIDANCE IS AVAILABLE FROM HAMILTON AFB

DRAWING LEGEND

	EXISTING	ULTIMATE
AIRFIELD PAVEMENT		
ABANDONED AIRFIELD PAVEMENT		
BUILDINGS		
PROPERTY LINE		
CLEAR ZONE		
BUILDING RESTRICTION LINE	BRL	
FENCE	—x—x—	
DRAINAGE DITCH		
GROUND CONTOURS (MSL)	~120~	
SECTION CORNERS		

BUILDING & FACILITY LEGEND

NO.	ITEM
1	TERMINAL BUILDING
2	AIR TRAFFIC CONTROL TOWER & ROTATING BEACON
3	FIXED BASE OPERATOR
4	AIRCRAFT STORAGE HANGARS
5	FIRE, CRASH & RESCUE STATION
6	AUTO PARKING
7	LIGHTED WIND CONE & SEGMENTED CIRCLE
8	EXPERIMENTAL AIRCRAFT ASSOCIATION
9	NON-AVIATION RELATED COUNTY FACILITIES
10	FAA REMOTE TRANSMITTER/ RECEIVER
11	SEWAGE TREATMENT FACILITY
12	LIGHT MANUFACTURING
13	FIRE ATTACK FACILITIES
14	T-HANGARS UNDER CONSTRUCTION
15	FUEL STORAGE (TO BE RELOCATED)
16	FUTURE FIRE/CRASH/RESCUE BUILDING
17	FUTURE FUEL STORAGE
18	MAIN POWER VAULT

RUNWAY DATA

	R/W 14L-32R		R/W 1-19		R/W 14R-32L	
	EXISTING	ULTIMATE	EXISTING	ULTIMATE 1/	EXISTING	ULTIMATE
PHYSICAL LENGTH & WIDTH	5111'X150' [1558X46]*	SAME	5000'X150' [1524X46]*	6000'X150' [1829X46]*	———	3200' x 60' [975 X 18]*
EFFECTIVE GRADIENT (%)	16	.13	.28	.23	———	.09
PAVEMENT STRENGTH 2/ (S,D,DT) (1000 #)	(33,49,78)	(60,100,175)	(48,70,110)	SAME	———	(13,—,—)
INSTRUMENT RUNWAY	✓	✓			———	
APPROACH SURFACE	14L=34:1	SAME	1=20:1	SAME	———	14R=20:1
	32R=50:1	SAME	19=20:1	SAME	———	32L=20:1
LANDING AIDS	14L-REILS	14L-VASI-4 REILS	1-NONE	SAME	———	14R-NONE
	32R-ILS,ALS	32R-ILS, ALS,VASI-4	19-NONE	SAME	———	32L-NONE
RUNWAY LIGHTING	HIRL	SAME	NONE	MIRL	———	MIRL
RUNWAY MARKING	PRECISION INSTRUMENT	SAME	BASIC	NON-PRECISION	———	BASIC

[ ]* DISTANCE DESIGNATED IN METERS
1/ POSSIBLE RUNWAY EXTENSION REQUIRES ADDITIONAL JUSTIFICATION AND EVALUATION; TIMING/LOCATION CONCLUSIONS NOT INCORPORATED IN THIS PLAN.
2/ PAVEMENT ANALYSIS TO BE COMPLETED FALL 1975

SUBMITTED BY:
SONOMA COUNTY, CALIFORNIA

APPROVED: CHAIRMAN, BOARD OF SUPERVISORS DATE

APPROVED: AVIATION DIRECTOR DATE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

APPROVED: CHIEF, AIRPORTS DIVISION DATE

NO.	BY	APP.	DATE	REVISIONS

SONOMA COUNTY AIRPORT
SANTA ROSA, CALIFORNIA

AIRPORT LAYOUT PLAN

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

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- Construct support taxiway for new runway.
- Expand terminal apron by 30,000 square yards.
- Provide 70 additional general aviation tie-down spaces.
- Construct 50 additional aircraft storage hangars.
- Expand terminal building by 5,000 square feet.
- Begin a land acquisition program to protect the approaches to the Airport.
- Install visual landing aids to Runway 14-32.
- Construct Fire Station and Maintenance building.

Intermediate-Range (1980-1984)

- Complete land acquisition program.
- Add 50 aircraft tie-down positions.
- Construct 50 additional aircraft storage hangars.
- Expand terminal building by 5,000 square feet.
- Modify terminal building parking lot and roadway.

Long-Range (beyond 1984)

- Enlarge aircraft tie-down and hangar areas.
- Expand terminal building.

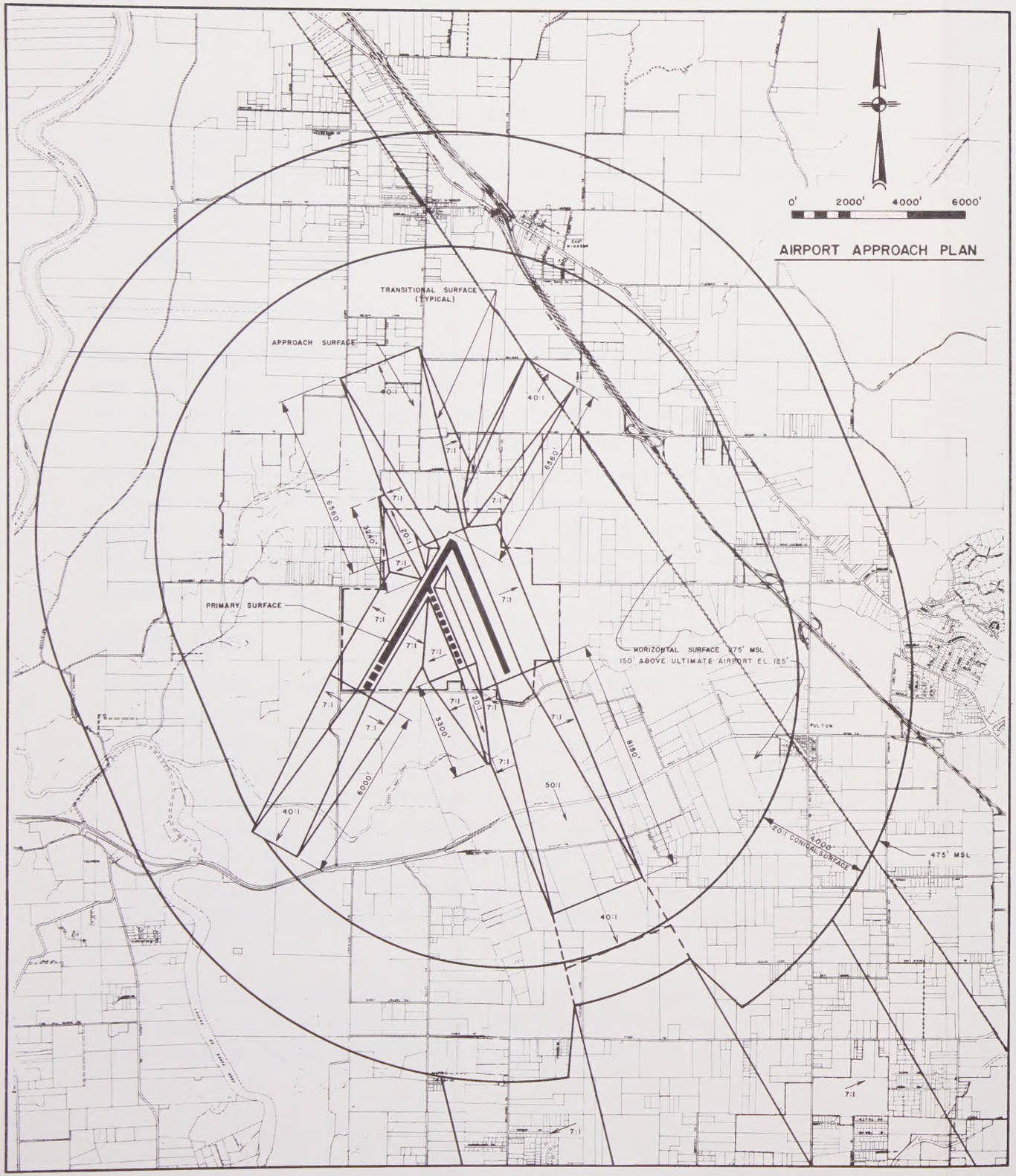
At this point in time it is not practical to stage the need for additional runway length at Sonoma County Airport, due to the many external factors affecting this decision. For consistency, none of the costs for this program will be included in the financial analysis. Likewise, none of the revenues resulting from the activity associated with the extension (i.e., increased scale of commercial activity) will be considered.

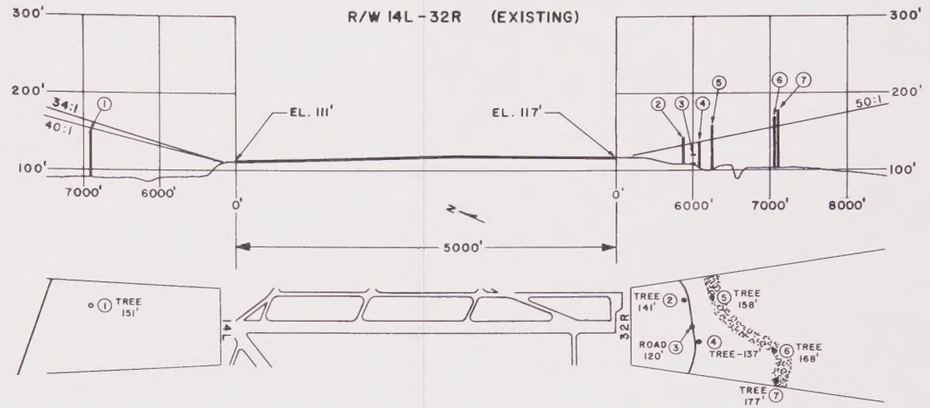
APPROACH AND CLEAR ZONE PLAN

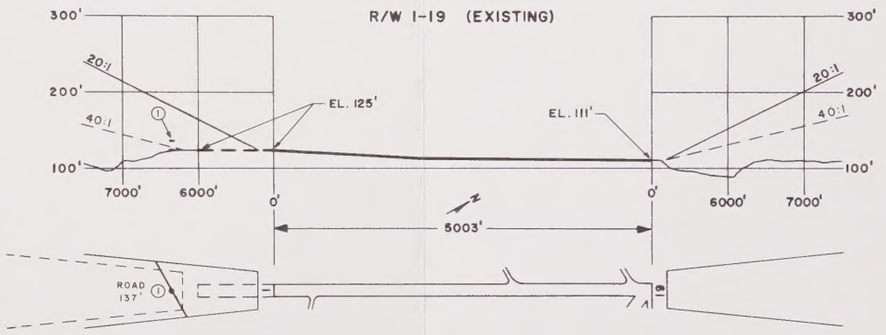
In order that the safe operation of aircraft into, out of, and around an airport may be insured, the FAA has adopted as part of the Federal Aviation Regulations (FAR), Part 77, "Obstructions Affecting Navigable Airspace". "Subpart C" of Part 77 sets forth standards for determining obstructions to air navigation. These regulations provide for the establishment of imaginary surfaces which no object, man-made or natural, should penetrate. The surfaces reflect the most recent standards set forth in the FAR's for determination of approach, transitional, horizontal, and conical surfaces. Drawing 5, Approach and Clear Zone Plan, depicts the imaginary surfaces developed for Sonoma County Airport for the operating conditions anticipated through the forecast period.

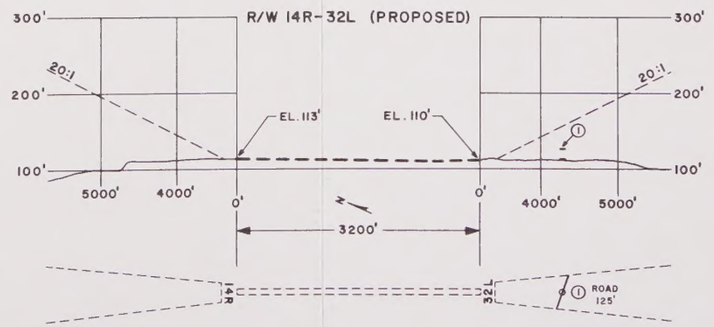
The dimensions and location of the imaginary surfaces are based upon the category of approach available or planned for each runway. Runways at Sonoma County Airport were classified as follows:

- Runway 32R: Precision Instrument
- Runway 14L: Nonprecision Instrument
- Runway 14R-32L (proposed): Visual Utility
- Runway 1-19: Visual Greater than Utility









RUNWAY APPROACH PROFILES

HORIZONTAL SCALE: 0' 1000' 2000' 3000'

VERTICAL SCALE: 0' 100' 200' 300'

NOTE: ROAD ELEVATIONS ALL INCLUDE THE 15' VERTICAL CLEARANCE REQUIREMENT

NOTE: ALL ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (MSL)

THE PREPARATION OF THIS DOCUMENT WAS FINANCED IN PART THROUGH AN AIRPORT MASTER PLANNING GRANT FROM THE DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, UNDER PROVISIONS OF THE AIRPORT AND AIRWAY DEVELOPMENT ACT OF 1970, AS AMENDED.

SONOMA COUNTY AIRPORT
SANTA ROSA, CALIFORNIA

APPROACH & CLEAR ZONE PLAN

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

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The Approach and Clear Zone Plan depicts the ultimate airfield configuration and, therefore, shows the height limitations placed upon the area by the addition of parallel Runway 14R-32L and a possible extension of Runway 1-19. Other pertinent dimensions for all runway approach and clear zone areas have been included in the drawing.

ON-AIRPORT LAND USE PLAN

There are essentially three categories of on-airport land uses: the airfield, aviation-related, and nonaviation-related areas. The airfield area is primarily composed of the runways, taxiways, and clear zones. Aviation-related land uses include fixed base operations, terminal buildings, automobile parking for airport users, aircraft parking spaces, hangars, etc. Nonaviation-related land use encompasses all other purposes for which airport property is utilized, including commercial, agricultural, industrial, and recreational.

Airfield Area

The establishment of land area requirements for runways and taxiways involves the reservation of additional land for clear zones, obstruction-free areas, and similar zones of operational protection. The dimensions of these zones are established by Federal Aviation Administration planning criteria and are depicted in Drawing 4, Airport Layout Plan. The use of land within the protective zones surrounding the runways and taxiways at Sonoma County Airport should be reserved for aircraft operations. The only allowable structures are those essential to aircraft navigation.

It is recommended that over the next 10 years, approximately 1,050 acres of property north and south of the Airport be brought under County control in order to protect the approaches

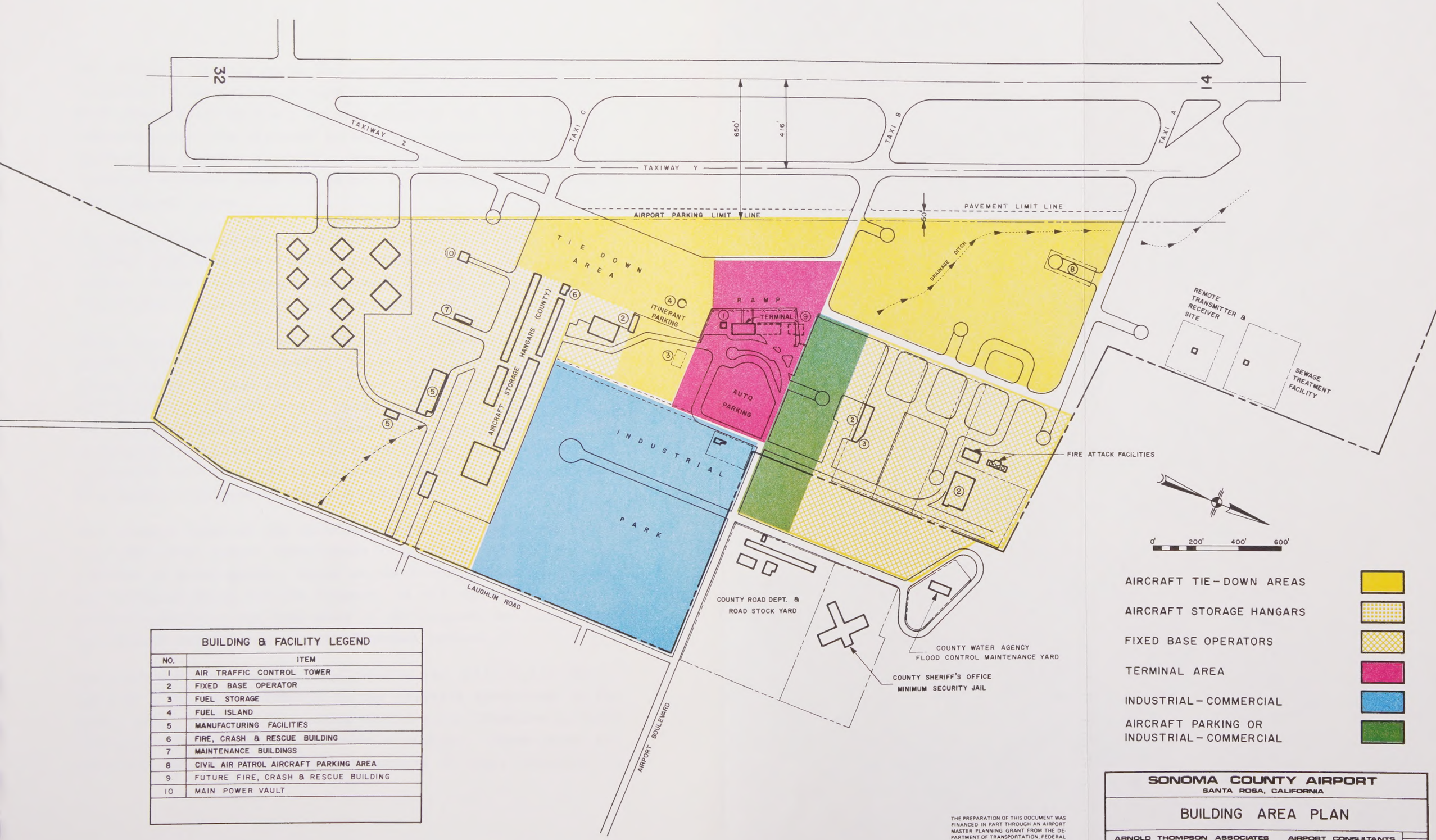
to the runways. Various controls may be used, but the County should ultimately have fee title to the clear zones for all runways. These clear zones should be free of all structures and obstacles. If it proves economically feasible, portions of this property could be utilized for revenue-producing agricultural purposes.

Aviation-Related Areas

The allocation of the additional acreage required for aviation-related land uses, such as terminal facilities, fixed base operations, hangars, and apron area, is based on gross area and operational requirements. The requirements for these facilities have been presented in Chapter VII and the relationship of this development to the recommended land use plan is depicted on Drawing 6, Building Area Plan.

Terminal Area: Public areas in the passenger terminal building are presently becoming very congested and some tenants of the terminal building are indicating a requirement for additional space. The existing 5,600-square foot terminal building is a single-level structure not capable of supporting a second level. It is recommended that in the near future the building be enlarged by approximately 5,000 square feet, with an extension to the north. This extension should be stressed so that a second level can be added when the demand arises.

With the terminal expansion into the parking lot north of the building, additional demand will be placed on the main terminal lot. Under its present configuration (132 spaces), adequate capacity will exist until the mid-1980's. When the capacity of the lot is reached, it should be redesigned to more efficiently use the space available before designating additional land for automobile parking. By changing the parking stalls from angled to perpendicular and redesigning the circulatory system, many additional parking spaces could be realized.



BUILDING & FACILITY LEGEND	
NO.	ITEM
1	AIR TRAFFIC CONTROL TOWER
2	FIXED BASE OPERATOR
3	FUEL STORAGE
4	FUEL ISLAND
5	MANUFACTURING FACILITIES
6	FIRE, CRASH & RESCUE BUILDING
7	MAINTENANCE BUILDINGS
8	CIVIL AIR PATROL AIRCRAFT PARKING AREA
9	FUTURE FIRE, CRASH & RESCUE BUILDING
10	MAIN POWER VAULT

THE PREPARATION OF THIS DOCUMENT WAS FINANCED IN PART THROUGH AN AIRPORT MASTER PLANNING GRANT FROM THE DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, UNDER PROVISIONS OF THE AIRPORT AND AIRWAY DEVELOPMENT ACT OF 1970, AS AMENDED.

SONOMA COUNTY AIRPORT
SANTA ROSA, CALIFORNIA

BUILDING AREA PLAN

ARNOLD THOMPSON ASSOCIATES AIRPORT CONSULTANTS
WILBUR SMITH & ASSOCIATES, INC. TRANSPORTATION PLANNERS

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The aircraft parking apron for air carriers extends 500 feet in front of the passenger terminal. This is ample space to park three short-haul air carrier aircraft (DC-9, B-737) and, depending upon the aircraft in service, provides many parking spaces for commuter aircraft. The ultimate demand of four commuter aircraft gates can be met with the space available on the terminal apron.

General Aviation Area: Area requirements for general aviation-related land uses are outlined in Chapter VII, Facility Requirements. These requirements were used as a basis in developing the following element of the on-airport land use plan.

There are two major areas which can be considered for additional general aviation development. There are approximately 180,000 square yards of land south of the existing T-hangar development and there are 110,000 square yards available north and west of the terminal complex. In recommending the areas for continued development, consideration was given to the drainage pipe and extensive fill required to completely develop the area north of the terminal between Taxiways A and B.

The acreage south of the existing hangar area should be utilized for additional hangar development in order to provide for continuity of development. Based on the T-hangar configuration presently proposed for the Airport, it will be necessary to allocate space on the west side of the Airport for hangar storage demand arising late in the forecast period.

Aircraft tie-down parking requirements can initially be met through a pavement extension of the existing apron/ramp to the apron limit line and the paving of the areas immediately north and south of the existing automobile parking. These areas are selected for initial development because of their proximity to

the terminal facilities and the aforementioned fill requirements northwest of the terminal. The complete development of this area will provide aircraft tie-down space well in excess of the 1985 demand.

The ultimate development (see Drawing 6) would require the leveling and paving of a significant portion of the land between Taxiways A and B. In recognition of this fact, any opportunity to acquire fill for this area should be utilized.

It should be noted that approximately 28,000 square yards north of the terminal building are designated as either aircraft tie-down area or commercial. This results from the fact that at the printing of this report, serious consideration is being given to the development of a large motel in this area. Five potential sites between the Airport and U.S. 101 are presently being considered. Since there is excess space available for aircraft parking areas, it is the Consultant's opinion that it would be to the Airport's financial advantage to lease this area to the motel. However, should this proposal fail to materialize, the area should then be used for aircraft parking as required.

Nonaviation-Related Areas

The amount of acreage within the airport's boundaries determines, to a degree, the types of additional land uses to be allowed and encouraged. A comparison of available land within the proposed boundaries and the gross area requirements outlined in Chapter VII indicates that there will be acreage excess to actual aviation needs. It is beyond the scope of this report to recommend specific types of use for this excess area; however, general types of uses can be recommended with the understanding that any type of on-airport development or land use be compatible with

the safety and operational requirements of the Airport. Specifically, all development should meet the height limitations and lateral displacement criteria required under FAA regulations. Additionally, items such as signing and lighting should be carefully controlled so as not to be distracting or confusing to pilots.

Areas considered excess to aviation needs have been designated in four general locations at Sonoma County Airport. The Building Area Plan (Drawing 6) illustrates an area east of the terminal and proposed aircraft storage areas reserved for commercial/industrial development. This plan is consistent with other studies and plans which have indicated the potential for an industrial park at the Airport. The second general area, as depicted on the Airport Layout Plan, is that property between the westerly restriction line for Runway 1-19 and the airport property line. Present access to this area diminishes its commercial potential and it is recommended that it be reserved for special use aviation and recreational activities. It would be particularly appropriate to encourage those activities which are both consistent with airport operations and contribute to the financial well-being of the Airport.

The third and fourth general areas established for nonaviation-related land use are those parcels north and south of the Airport which are recommended for acquisition. These areas considered excess to aviation needs are exclusive of the land within the ultimate clear zones as illustrated on the Airport Layout Plan. Particular emphasis should be placed on maintaining the land use within these areas as agriculture or low-density recreational, as continued land use compatibility is the primary justification for their purchase.

IX - OFF-AIRPORT LAND USE

INVENTORY

The boundaries of the off-airport land use study area (sometimes referred to as the airport environs) define an octagonal region covering approximately 2.5 miles in every direction from Sonoma County Airport. Current land use characteristics and trends within this study area provide the context for formulating policies and plans that will guide and coordinate compatible land use activities and maintain environmental quality in the airport vicinity.

The study area is an unincorporated area under Sonoma County jurisdiction. The southeast half of the study area is within the Sphere of Influence of the City of Santa Rosa, as adopted by the Local Agency Formation Commission, and therefore is included in all major Santa Rosa General Plan studies.

Although the study area is essentially rural in character -- a mix of open space, agriculture, and dispersed rural development -- the lands east of the Northwestern Railroad tracks are becoming an urban corridor between the Larkfield and Windsor areas.

To assist in describing and analyzing the study area, it was divided into six subareas which are relatively homogeneous in character. These subareas and the existing land uses of the study area are shown in Figure 11. The subareas have different types of land uses, governmental jurisdictions, and issues requiring separate policy treatment. For example, agricultural and open space issues are important in the Laguna-Mark West Creek area. In the Larkfield, Windsor, and Piner-Fulton areas, issues related to urbanization and governmental jurisdictions are important.

The Russian River Subarea is the portion of the Russian River plain traversing the northwest corner of the study area. It is a

EXISTING LAND USE MAP

RESIDENTIAL
COMMERCIAL
PUBLIC SERVICE
INDUSTRIAL
AGRICULTURAL
VACANT

0 2000 4000 FEET

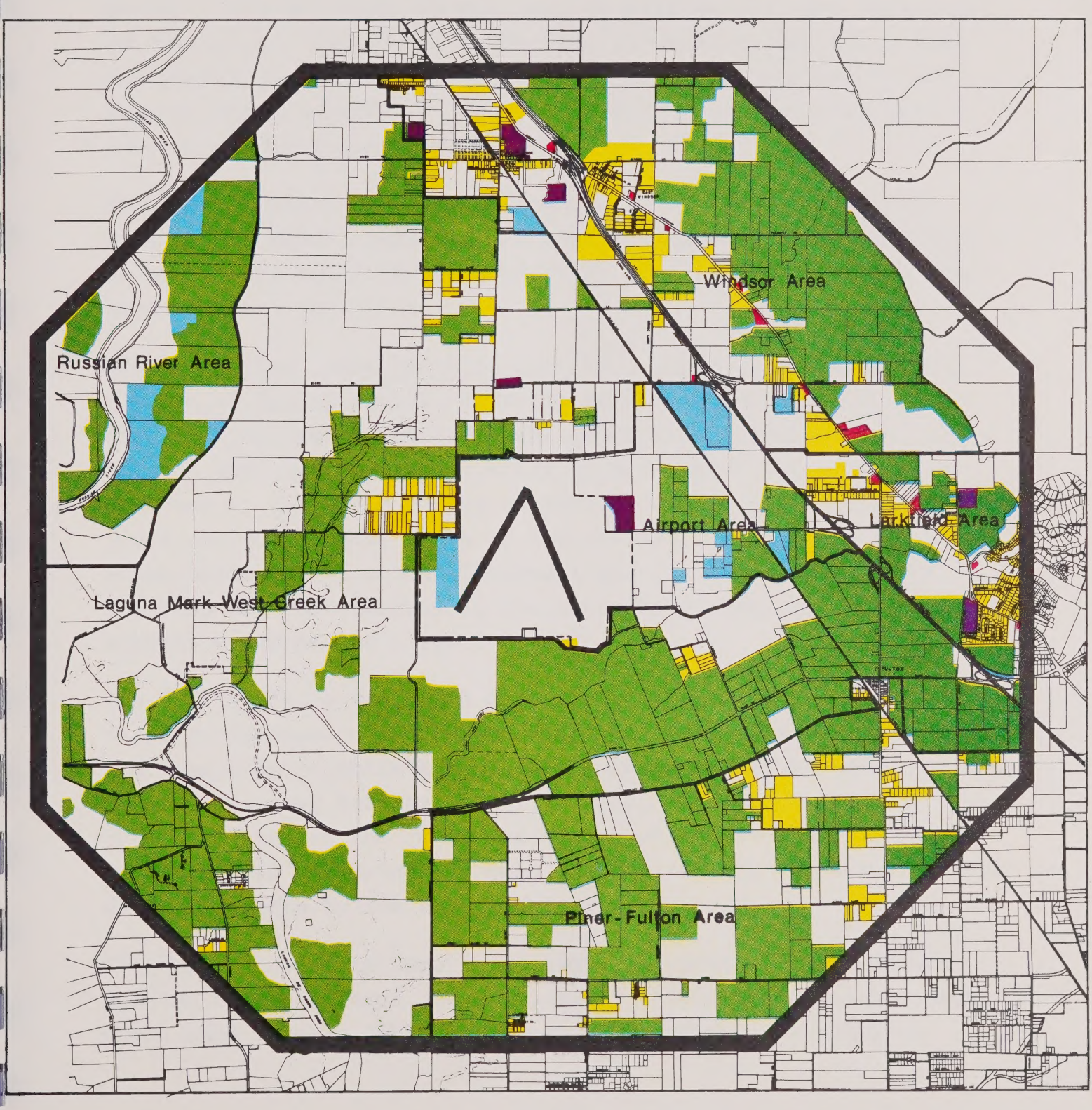


FIGURE 11

flat, low-lying area with Class 1 soil deposits from the River and subject to periodic flooding. Along the Russian River, open grass land predominates, spotted with brush and broad-leaf forest. The remainder of the area is agricultural and industrial in character. Agricultural activity is conducted on large farm holdings and consists of cultivated field and truck crops, orchards, and vineyards. Mining activity in the area consists of four stone and gravel quarries.

The Russian River area is isolated from the rest of the study area by the woody ridge running east of Eastside Road. The area is stable and exhibits few signs that land uses will change from their present character.

The Laguna-Mark West Creek Subarea is a large area surrounding the Sonoma County Airport from the northwest to southeast. The area is comprised of agricultural lands directly south of the Airport and flat plains and hills to the west. The area to the west and to the south of the Airport is within the 100-year flood level contour. Lands south of the Airport are for the most part prime agricultural soils (Classes 1 and 2). Mark West Creek, the last natural waterway in the Santa Rosa area, traverses this subarea south of the Airport.

The flat plain to the south of the Airport is used for agricultural production -- cultivated field and truck crops, orchards, and vineyards -- while the plains to the west and north of the Airport are used for livestock, dairies, and poultry production. The hilly area in the southwest corner of the subarea toward Sebastopol is predominantly open grass land with broad-leaf forest extending north to the Russian River plain.

Generally, ownerships are large (100-160 acres) in the western portion of the subarea, becoming small (15-50 acres) to the east where road access, urban services, job markets, and shopping

areas are close by. Land values are lower to the west, ranging from $500 per acre along the Russian River to more than $2,100 per acre between the Northwestern Pacific Railroad and U.S. Highway 101.

The eastern portion of the subarea along the railroad and U.S. 101 is beginning to change from rural to urban uses. Small ownerships north of Fulton are still used for peach and plum orchards. Although the trees are not infected with glamosis, a bacterial disease which has reduced production east of the highway, owners have indicated desire to sell their property for urban development. They generally opposed the agricultural zoning proposed for the area, which requires a minimum lot size of 20 acres. The land along the railroad north of the Airport is varied and also beginning to undergo change. Scattered development, investment in land for development, and other predevelopment activity is occurring outside the Windsor County Water District boundary, along River Road and Star Road to the limit of the North Clear Zone approach, south of Reiman Lane and directly west of the Airport. Large parcels in the area (100 to 200 acres) are being used for new agri-business. New vineyards have been planted south of Windsor; livestock activities in the area include dairies, horse raising, and poultry.

The Piner-Fulton Subarea is located in the southeast part of the study area. The land in this area is comprised primarily of Class 3 and 4 soils with hard claypan subsoil. Although these soils are not usually conducive to agriculture, high surface soil fertility has resulted in intensive farming of about 60% of the subarea.

Ownerships in the Piner-Fulton area are generally 100 acres or larger; however, there are small lots along Piner Road, Fulton Road, and Wood Road where residential subdivision and lot-split

housing has occurred. One to ten acre ranchettes are typical along the northwest fringe of Santa Rosa. These support a few livestock or vineyards and are increasingly in demand as more people desire a country life style.

The Fulton area was originally centered around a small railroad village. Housing in Fulton is generally poor to dilapidated. Small ownerships (1 to 5 acres) characterize the southern Fulton area. Although this area is not yet urban, it is undergoing substantial predevelopment activity as urbanization extends north from Santa Rosa. The Santa Rosa City Council agreed (September 1973) to provide a sewer trunk line to the Fulton area in the event of an environmental health problem. However, there has been no agreement regarding actual extension, construction, or financing of such a system. If urban services are extended into the area, a significant change from rural to urban land use is likely; however, the extent of such change is a function of land use and zoning decisions made by the County.

The Larkfield Subarea is a triangular area extending east from U.S. Highway 101. The area is characterized by gentle hills and poorer soils. Orchards, which were once the prime agricultural use, are disappearing as the area is urbanized.

Suburban communities are being developed in the area characterized by hillside subdivision housing, apartments, mobile home complexes, a condominium, and a golf course.

Issues regarding suitability of the subarea for urbanization and government jurisdiction for sewer and water services have arisen as a result of the pace of change in this area.

The Airport Subarea includes the airport property and extends east to the highway. Prime agricultural soils extend from Airport Boulevard to the Mark West Creek area. The southern portion of this subarea is within the 100-year flood plain.

The area is comprised of a mix of industrial agricultural, and airport uses, with small to medium sized parcels (10 to 60 acres) of vacant land.

Most of the existing industrial development in this subarea is located west of the highway on Airport Boulevard and Shiloh Road. The principal industries process wood or produce wood-related products. Other industrial production includes steel manufacturing and cooling systems. Some older lumber companies which were located south of Airport Boulevard have closed down.

About 640 acres of land in the subarea are zoned for industry; less than one-third of this land is used now by industry, about 120 acres is still in agricultural production (vineyards and orchards), and the remainder is vacant except for a few rural homes.

The Windsor Subarea includes the small village of Windsor, a semi-urban corridor east of the Northwestern Pacific Railroad, and the flat plains east of this corridor. Windsor and this corridor are an unincorporated area along U.S. 101 and the Old Redwood Highway generally corresponding to the Windsor County Water District boundary. The area may soon have a specific land use plan and updated zoning plan adopted by the Board of Supervisors. Public hearings are currently being held on the specific land use plan.

Large ownerships and agricultural production (mainly orchards and some vineyards) are typical of the flat plains east of the highway. West of U.S. 101, a few parcels remain in orchard production. Housing development is generally dispersed along Old Redwood Highway and includes five large mobile home parks.

The area west of U.S. 101 is generally served by urban utilities. Water is already provided along Old Redwood Highway and more generally in the vicinity of Windsor to Wilson Lane. Sewer

service is provided throughout the entire Windsor County Water District. Considerable development and predevelopment activity is occurring both inside and outside the Water District boundaries, but there has been increased interest where sewer service is available. In the past, there has been significant splitting of ownerships into smaller lots, but this activity is decreasing as owners appear to be waiting for full urban subdivisions rather than casual lot splits. Some of the factors that supported economic agricultural production now provide a strong incentive for large-scale residential development in the area. Large holdings (relatively inexpensive and flat land), proximity of services, easy access, and an attractive environment are encouraging the spread of urban growth. Examples of this activity are approvals for 500 dwelling units south of the Water District boundary and the Larkwood Hill development northeast of Windsor, a planned residential development of 1,488 dwelling units.

CURRENT PLANS AFFECTING LAND USE WITHIN THE OFF-AIRPORT STUDY AREA

A wide range of plans, objectives, policies, and programs affect the current and future use of land surrounding the Sonoma County Airport. These consist of both public and private proposals. Current public planning and implementation instruments affecting development include an existing general plan, which is being revised and expanded to include new action programs, land use studies, transportation studies, capital improvement programs, zoning and subdivision ordinances, and health and pollution regulations.

Although the airport environs fall within the governing and planning jurisdictions of Sonoma County, the Santa Rosa Sphere of Influence and planning area includes a large part of the study area. The need for coordination of public and private plans and action programs is becoming increasingly apparent.

The anticipated expansion of airport facilities and Santa Rosa's growth have created substantial interest in rezoning, development, and speculative investment within the study area. The Airport Zoning District and the Windsor Specific Plan are the most effective instruments for governmental regulation of such development pending the adoption of a master plan for the Airport and environs.

A discussion of the current status of pertinent plans affecting the airport environs follows.

City Plans and Planning Studies

The Santa Rosa Area General Plan (1967-68): The plan is being revised to reflect changing conditions and attitudes, as well as to meet new state planning law requirements. Planning intentions regarding the airport environs have been substantially changed from those contained in the plan, as a result of subsequent detailed studies and public involvement on issues of growth, agribusiness, and environmental quality.

The General Plan boundary includes the Airport and approximately the southeast half of Sonoma County Airport Study Area. This boundary was utilized throughout all Santa Rosa planning studies and defines the City's Interim Sphere of Influence.

The 1968 General Plan sets forth goals and policy implications to encourage a compact growth pattern and discourages inefficient sprawl throughout the Santa Rosa Planning Area. It calls for the maintenance and improvement of existing residential areas; strengthening of the downtown area as a governmental, financial, trade, and convention center for the entire Planning Area; the enhancement of Santa Rosa's potential industrial growth; and the preservation of the aesthetic qualities of its natural environment.

The General Plan does not establish agriculture as a viable land use or as a means for providing open space and controlling growth, although the preservation of natural waterways and a system of trails was included in the plan.

The General Plan recommends four land use types in the airport environs:

1. The portion of the planning area below the 75-foot elevation level and southwest of the Airport has been designated as a flood plain area. The Mark West Creek is a major element of a program for the retention of natural waterways.

2. Areas north, west, and south of the Airport for which convenient economical extension of utilities and other governmental services are not accessible are designated as low density intermediate residential (0-1 unit per acre).

3. A major industrial park complex is proposed east of the Airport.

4. East of Highway 101, a mix of low and medium density residential related to commercial and public neighborhood facilities is shown.

As recommended in the General Plan, further specific studies have been made.

Natural Waterways Study (1969): This study is a well designed and thoroughly documented analysis of natural and man-made waterways of the Santa Rosa area. The study criticized past creek modification procedures which in many instances were inequitable to the developer and oriented to the single purpose of flood control based upon a "lease-cost" approach and which did not consider

unquantifiable values such as preserving needed natural landscapes and related recreational uses.

Survey and analyses of existing waterways showed that a major portion of the natural waterways have been obliterated. The study makes mandatory the retention of remaining waterways in as near their natural state as possible. Fulton and Airport Creeks are also mentioned as worthwhile saving. Finally, the study presents alternative designs having adequate hydraulic capacity while retaining the natural amenities of the landscape.

Santa Rosa Optimum Growth Study (1972): This study presents a comparative analysis of a minimum and maximum possible growth (140,000-250,000) of the Santa Rosa Planning Area in the next 20 years. Although the study does not foresee serious negative impacts due to accelerated growth, it does recommend several programs to oppose scattered development and ensure that vital open spaces are preserved.

Flat land with large ownerships in the West Plains makes up the greatest potential of future growth. The most important factor that will influence development patterns south of the Airport will be the trunk sewer connection to the airport plant. Development is already underway in the east part of the Piner-Fulton subarea.

In its conclusions, the study shows that there is no growth crisis in Santa Rosa; but if thinly spread development occurs in unincorporated territory, a double cost will be incurred to the City in later annexation: (1) cost of scattered development and (2) improvements to bring services up to generally higher City standards.

Another consideration, perhaps a more important one, is that remedies for pollution and other urban problems either exist or are within sight, but open space is irreplaceable. Therefore, a major recommendation of the study is the preparation of a specific open space plan.

The Open Space and Conservation Element was adopted in March 1973 as an element of the new General Plan. Goals and policies were presented under major headings. Only the headings related to the study area have been reviewed: the Natural Waterways Environment, the Laguna, and the Agricultural Lands.

- The Natural Waterways Environment - GOAL 1 recognizes that community mental health and well being depend to a great extent on the availability of natural environments and settings. Therefore, natural waterways should be protected and means devised to restore already modified channels. The Waterway Combining District was adopted to provide Santa Rosa with the appropriate zoning measures. The creeks outside city limits, but within the General Plan area, for which the Waterways Combining District Ordinance applies as a recommended policy only are: Mark West, Fulton, and Airport creeks. GOAL 2 indicates that flood plain protection should be established at the 100-year flood level when possible or to a lesser standard whenever the natural appearance of the waterway can be maintained. GOAL 3 recognizes that waterways are a resource for a variety of open space uses and a critical link in a potential trail system -- not merely drainage channels.

- The Laguna Environment - The value of the Laguna flood plain for agricultural uses (mainly irrigated pasture) is recognized. Such use is compatible with other goals such as greenbelt, an airshed, scenic open space, and wildlife habitat; therefore, preserving the Laguna plain from development is considered desirable.

- The Agricultural Plains Environment - The general goal is to encourage prudent land management and farming practices, maintaining the agricultural uses of prime soil areas. Careful consideration should be given to deferring near prime agricultural land from urban development that may be worth preserving for a variety of open space uses.

Plan for Housing (August 1972): This plan sets forth goals and action plans for better housing and deals with specific issues expressed over the past years by the Community Relations Committee, the Planning Commission, and previous publications of the Planning Department. The Housing and Urban Development Act of 1968 reaffirming the national goal of "a decent home and a suitable living environment for every American family" is accepted as a primary housing goal.

Wastewater Irrigation Study for the City of Santa Rosa: This study was developed to test the economic, technical, and environmental feasibility of disposing wastewater by sprinkler irrigation on agricultural lands. The report findings indicate that this alternative of disposing wastewater to the profit of agriculture is a feasible and competitive alternative.

Sonoma County Planning Studies

The County planning staff is currently involved in a long-term effort for the preparation of Elements of the County General Plan. The General Plan concepts will be forthcoming in 1975. Two mandatory General Plan Elements have been completed: the Housing Element and the Open Space Element.

Parallel to this general planning effort, the County is involved in specific studies such as the Larkfield County Airport Land Use Study, the Windsor Environs Study, and the Interim Open Space Zoning District.

The County General Plan is intended to be a comprehensive long-term guide to the growth of Sonoma County. When completed, the General Plan will consist of:

- Generalized descriptions of the social, economic, and environmental characteristics of Sonoma County.
- An evaluation of the interrelationships of those elements and the consequences of various growth alternatives chosen for study.
- A generalized description of the physical form of growth which City and County policymakers have elected to encourage.
- A general description of the location and extent of basic public services needed to support the preferred growth option.
- Recommended policies and programs for implementation of the General Plan goals.

The Open Space Element: In accordance with State mandates, Sonoma County prepared and adopted Phase I and the Interim Plan of the Open Space Element in June 1972. This element includes: a report on open space issues of the County, a natural resources inventory and identification of areas of Statewide significance and critical concern, the goals developed by the Citizens Advisory Committee, and an action program for conserving open space and prime agricultural areas.

Composite sensitivity maps have been prepared (Phase II). Once combined with Land Use Suitability maps, they will be used to generate maps showing areas of potential environmental conflict (Phase III).

For the Airport Study Area, the Hazardous Areas Map indicates high and medium-high hazard east of Old Redwood Highway and medium-high and medium hazard along the Russian River, south of Windsor, the Airport itself, and more generally on the west half of the study area. A city geology map further indicates that hazardous areas generally correspond to Glenn Ellen soils west or on the Healdsburg fault.

The composite sensitive area map contains information regarding critical processes and systems that could be permanently degraded by urban or rural activities. Critical areas are generally found west of the Airport and along Mark West Creek.

The Sonoma County Citizens Advisory Committee on Open Space, Conservation, and Recreation identified a set of goals and policies under six general open space categories.

Finally, a specific set of County policies related to airports recommends:

- Development of Sonoma County Airport as the only feeder airport in the County capable of handling medium commercial carriers.
- Establishment or increase in clear zones to provide adequate safety margins and insure that residential areas are not subjected to excessive noise levels.
- Avoidance of residential development in the airport approach zone.

Analysis of Housing, A Study of Contradictions (August 1973):
This study was prepared as part of the County General Plan program. The report identifies in detail the nature of housing problems in the County. At the outset, basic housing goals have been defined to assert more precisely the general goal of adequate housing for all:

- GOAL 1 - controlled growth around a central core with greenbelts.

- GOAL 2 - devise strategies involving both the public and private sectors to provide adequate low and moderate income housing (no one should have to pay more than 25% of annual income in housing).

- GOAL 3 - need for a variety of housing in the rental and ownership market, and diversity of density that is consistent with area and needs.

- GOAL 4 - eliminate racial and ethnic discrimination.

- GOAL 5 - coordination of planning and public works agencies to assess anticipated growth and impact on the social, economic, and environmental issues of the County.

The Windsor area is generally mentioned as one critical area. Percentage-wise to total dwelling units, extensive low-cost housing has been built under the Farmers Home Administration 502 Program. Substandard housing and overcrowding is characteristic of the area.

Housing Element of the Sonoma County General Plan (Adopted August 1973): This report contains (1) the Citizens Advisory Committee's (CAC) goals for housing which have been adopted by the Board of Supervisors and previously mentioned, and (2) the recommendation for action proposed by the CAC to implement the goals for housing.

A further analysis of the County housing dynamics indicates that two modes of development are occurring simultaneously in Sonoma County -- the "rural" mode and the "urban" mode. The models for rural development are lot-splitting and large lot subdivisions.

This lot-split process, which reduces parcel size haphazardly within the City's Spheres of Influence, encourages the semi-urban sprawl that the Local Agency Formation Commission (LAFCO) was set up to discourage.

There is, therefore, a definite need for safeguarding suitable lands for urban development especially when considering moderate and low income housing if the private sector is to participate in a meaningful way in providing such housing. In addition, lot-splitting can be undesirable because of deferred and unforeseen public cost while consuming land now under agricultural production.

Lot-splits occur in unincorporated areas in small communities lacking a general plan like the Windsor area or the Fulton area, and in uncentered growth areas like the Piner-Olivet area.

Recommended actions stipulate the feasibility of the mix housing concept where an adequate infrastructure of service facilities is available. Further studies concerning ownership and subsidy methods directly to the individual are proposed.

Restoring the Future: A case study that was used to develop an economic calculus tool (cost/benefit analysis) for public agencies. It recognizes that the all array of externalities, social cost, intangibles, and secondary effects are probably more important and far-reaching than the simple account of extending facilities and services.

The small rural village of Windsor, that until recently ran on a local infrastructure of wells, septic tanks, volunteer firemen, and a small village school, was chosen as a case study. Presently, Windsor is an unincorporated place without urban police, fire services, and other service. A Municipal Advisory Council has been recently elected and the County planning staff is preparing a land use study for the Area.

Larkfield County Airport Land Use Study (1973): This study was prepared to assert ultimate land use densities in the area east of the Airport to the hills for the Public Works' Sanitation Unit.

This area, as the Windsor area, is critical as significant residential development has taken place since the late 1950's. Today the Larkfield area has a definite urban appearance with the development of a condominium, golf course, and hillside subdivision in Wikiup, and rezoning allowing apartment units and mobile home park complexes. Accompanying the increase in residential densities was rezoning from rural residential or agricultural to commercial along Old Redwood Highway. Proposals are now in the County Planning Department for an additional 200 acres of single-family dwellings. Service problems arise as the majority of approved subdivision, lot-splits, and rezoning to single- and multiple-residential and commercial uses were made on a day-to-day basis with no overall planning guidance. A significant part of the County and Santa Rosa area growth is expected to occur in this area and south of Windsor.

It was, therefore, the general conclusion of the study that the central part of the proposed sanitary district will be at urban densities comparable to the City of Santa Rosa and that the industrial section will be eventually developed as proposed by the Economic Development Board. The following recommendations were expressed:

- Public sewers should be provided in at least portions of the Larkfield area and encourage a city-centered growth pattern.

- Densities in single-family residential areas should be no more than three units per acre. The area could accommodate 15,000 to 21,000 in addition to existing developed areas.

- To encourage (1) the preservation of agricultural lands (with appropriate tax relief measures); (2) the creation and funding of greenbelts between Larkfield, Santa Rosa, and Windsor; (3) the use of planned area zoning techniques; and (4) further studies to determine the feasibility of protecting Mark West Creek.

- Rezone and establish large minimum lot sizes to stop: uncontrolled lot-splitting of large parcels in sewered lands that should be subdivided, bad sanitary conditions in areas never to be sewered, and elimination of existing prime agricultural lands in areas clearly suitable for permanent agricultural activity.

- In those areas to be sewered, steps should be commenced now for either eventual incorporation or annexation to the City of Santa Rosa. It should be mentioned that the City has indicated similar conclusions.

- Further studies should be undertaken in cooperation with recognized citizens groups to develop a specific plan prior to private development.

The Windsor Environs Study: The County Planning Department, at the request of the Sonoma County Board of Supervisors, is currently preparing a specific land use plan for the Windsor area. This plan, which is presently being reviewed with citizens and affected agencies, has been considered during the preparation of the recommended airport land use plan.

Land Use Controls

Land use controls are based on planning considerations, and administered by the County through zoning, use permits, variances, and

subdivision/lot-split regulations. Those documents specify permitted and conditional uses; apply to the construction, alteration, and maintenance of structures; and are designed to prevent incompatible uses and preserve lands for future development.

Most critical lands in the study area are included in the Airport "S" District study. A staff report, Airport "S" Study Area, was presented to the County Planning Commission (August 16, 1973) for the adoption of new zoning regulations for the vicinity east of the Airport and limited by U.S. 101. The zoning plan should be considered as interim until the adoption of a General Plan for the airport environs. All zoning proposed is at least as restrictive or more than the previous zoning; thus, an environmental statement was not required.

The content of the report and the Commission amendments indicate a strong opposition to residential development in the airport vicinity, while supporting the preservation of agricultural lands (minimum lot size: 20 acres). The protection of Mark West Creek as a scenic asset is recognized. A primary goal for industrial development is to encourage modern non-nuisance industries, research labs, office uses, and other uses compatible with an airport. Zoning regulations are:

- Lands north, northwest, and southeast of the Airport are included in the Agricultural District where residential development (one acre per unit minimum) is conditionally permitted.

- In the Windsor and Larkfield areas, subdivisions of various densities (0.88 unit to 20 units per acre maximum) are permitted.

- Lands west of the Airport are generally included in the primary or secondary flood plain district, except for a small area under the Combined Rural Residential District (5 acre minimum).

- Finally, south of the Airport, lands are in agricultural preserves or as in the quadrangle Piner Road, Oakwild Lane, River Road, and Hartman Lane in the Combined Agricultural District (one acre minimum per building site area).

California State Laws

Airport Land Use Commission: The Commission was established under the Public Utilities Code Section 21670 and was considered necessary because of conflicting and parochial laws and regulations concerning land uses in the vicinity of airports. Self-serving communities had allowed buildings and land use in areas where there was direct conflict with established airports. This had led to the closing of some airports because of ecological considerations or operational limitations which imposed burdens upon the pilots and corporations involved.

The powers and duties of the Commission are detailed in Section 21674; briefly, they are:

- To study and make recommendations necessary in the interest of the public health (noise and air pollution) and public safety (height limit restrictions).
- To make recommendations involving compatible land use adjacent to an airport.
- To hold public hearings and make available the findings.

State Environmental Impact Statements: California public agencies are required to prepare and evaluate Environmental Impact Reports (EIR's) on projects which would have a significant effect on the environment as specified by the California Environmental Quality Act of 1970 (CEQA), Chapter 1433; Statutes of 1970; Public Resources Code Sections 21000-21174, amended by Chapter 1154; and Statutes of 1972 (AB889).

Guidelines for the preparation and evaluation of Environmental Impact Reports were prepared by the Resource Agency of California. The content of Environmental Impact reports includes the following:

- A description of the project, including: (1) location of the action on a regional map with significant environmental areas and landmarks indicated in relation to the project area, (2) a statement of objectives, and (3) a general description of the project's physical characteristics.

- A description of the environment as it exists from both a local and a regional perspective.

- An environmental impact analysis that describes: (1) the direct and indirect impacts of the proposed action, (2) any adverse environmental impacts which cannot be avoided, (3) mitigation measures proposed to minimize the impact, (4) alternatives to the proposed action, (5) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, (6) any irreversible environmental changes, and (7) the growth-inducing impact of the proposed action.

1995 OFF-AIRPORT LAND USE PLANS AND POLICIES

Airport operations, by their very nature, affect areas around an airport, especially the area immediately adjacent to the airport boundary and under aircraft flight paths. These areas are affected by aircraft noise, air pollution, and safety considerations, both in the approach area and on the ground below it.

Conversely, airports are also affected by the type and location of development surrounding an airport. Airport-related industrial development close to an airport, for example, can provide economic benefits to an airport and surrounding communities.

For these reasons and because airport impacts are multi-jurisdictional and regional in scope, it is essential that airport-related land use decisions be based upon a comprehensive analysis of existing and future conditions.

As a part of the transportation system, an airport must be related to the surface transportation system and to other existing and planned public facilities and land uses within the area it serves and affects. As a facility with special functional, support, and safety needs, an airport places certain requirements on the area surrounding it. These requirements must be carefully coordinated with the land uses in the area directly affected by the airport and the intergovernmental policies, plans, and programs for the area.

The recommended land use policies which are presented herein are intended to provide a basis for evaluating future land use and public policy decisions within the airport study area. It does not, however, provide a final finite conceptual future land use plan or detailed performance standards. Rather, the recommendations are designed to become a part of the County's comprehensive planning program by indicating important implications of airport development and operations, as well as the interface between existing area plans and the recommended airport development program.

Joint, mutually dependent objectives are recognized:

- To foster and protect airport development in order to optimize its potential service to the region; and

- To enhance and protect the environment, as well as orderly growth and development, in order to minimize adverse impacts of air transportation services.

Stated perhaps oversimplified, those plans and actions that protect the airport also protect its environs.

Planning Considerations

The analysis of future land use for the Sonoma County Airport environs (study area) is structured in seven parts: noise, air pollution, flight safety, obstruction, capacities of public facilities, environmental suitability, and economic and functional feasibility.

Noise: Noise, or unwanted sound, can be one of the most influential and pervasive environmental impacts of airport activity. Noise pollution has been associated with hearing damage, speech interference, hypertension, disruption of sleep or rest, social problems, mental distress, and pain. Excessive noise has also been shown to have an adverse physiological impact on animals.

The sensitivity of particular land uses to various levels of aircraft noise has been the subject of research by acoustical consultants Bolt, Beranek, and Newman. The land use compatibility guides developed from this research are contained in the following tabulation.

Land Use	<30 NEF	30-40 NEF	>40 NEF
Residential	Yes	Yes[1/]	No
Commercial	Yes	Yes	Yes[2/]
Hotel/Motel	Yes	Yes[2/]	No
Office and Public Buildings	Yes	Yes[2/]	No
Schools/Hospitals/Churches	Yes[2/]	No	No
Theaters and Auditoriums	Yes[2/]	No	No
Outdoor Recreation	Yes	Yes	Yes
Industrial	Yes	Yes	Yes[2/]
Agricultural	Yes	Yes	Yes

1/ Single dwelling structures should be avoided. Multi-family dwellings may require soundproofing.

2/ Acoustical studies should be conducted to determine if noise proofing is required.

Source: Bolt, Beranek, and Newman, Inc., Procedures for Developing Noise Exposure Forecast Areas for Aircraft Flight Operations, August 1967.

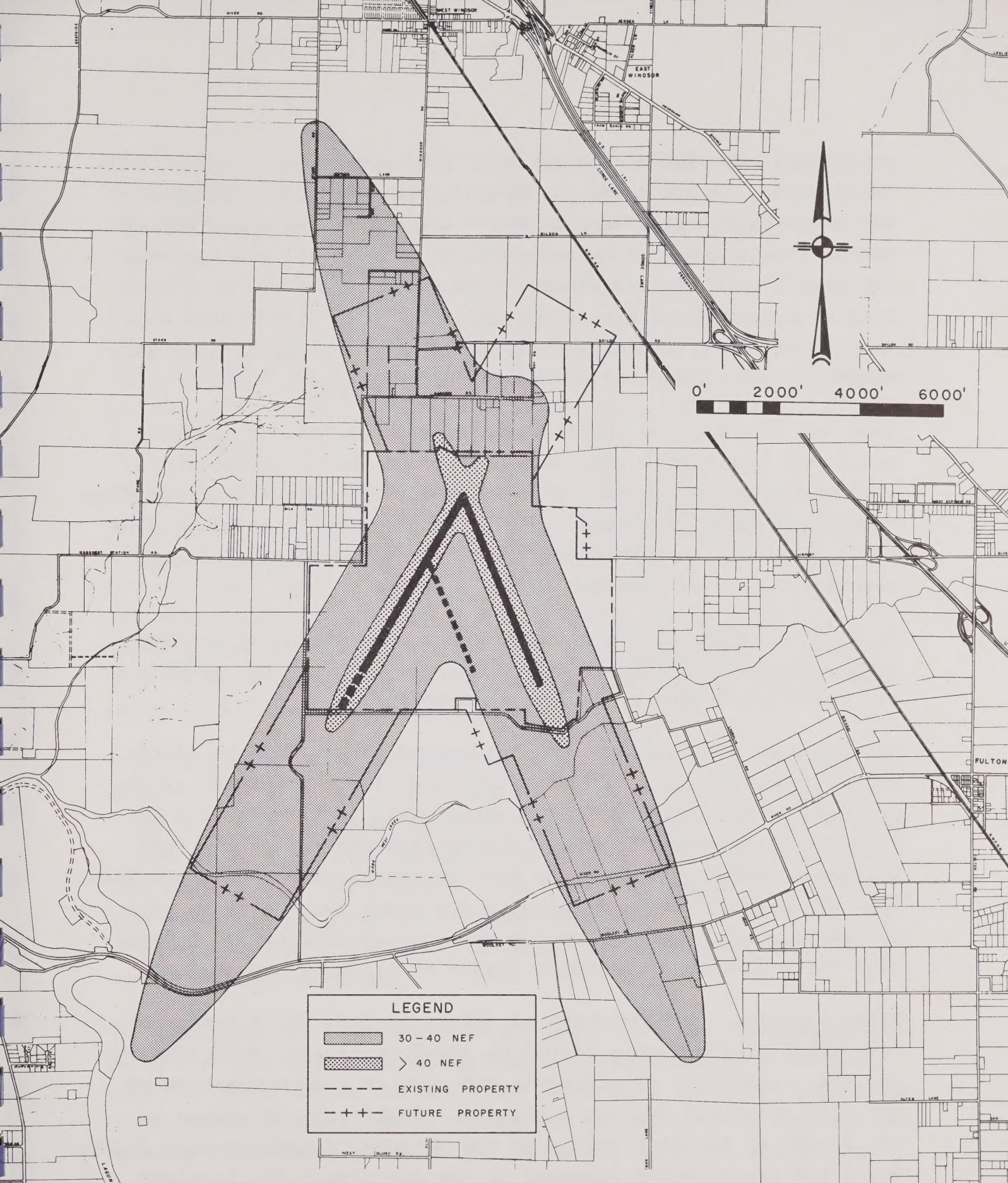
These guides are subject to variations based upon subjective reactions and in recognition of activities having varying sensitivities within a particular land use category. Generally, it has been concluded that residential, public and quasi-public land use categories are the most sensitive to noise, with agriculture, open space, industrial/manufacturing, transportation, communications, and utilities the least sensitive to noise.

The projected ultimate noise contours shown in Figure 12 indicate that the 40-NEF noise contour would essentially be contained within existing airport property limits. The ultimate 30-NEF contour does extend beyond the proposed airport boundaries both to the north and to the south. The potential noise impact shown south and west of the Airport arises from the possibility that Runway 19 may be utilized to a greater extent for departures by jet aircraft. No noise contour was generated for the proposed parallel runway since it is designed to accommodate only small piston-powered aircraft with a small noise output. More detailed information concerning the development of the noise contours can be found in Appendix A, General Environmental Assessment.

Most of the land within the 30-NEF contour is agricultural, vacant, or rural residential. Most of the existing residential development is located north of the Airport and is of low density. The existing residential structures south of Reiman Lane, between Starr Road and Oak Way, would be within the ultimate 30-NEF contour. A northern extension of Runway 14-32 would generally increase the ultimate noise on these residential structures.

For those areas outside airport boundaries, but within the 30-NEF contour, the existing low-density agricultural zoning should be maintained.

Air Pollution: Air pollution from aircraft emissions is known to affect humans and natural flora and fauna adversely. Air



ULTIMATE NOISE EXPOSURE FORECAST

FIGURE 12

pollutants associated with aircraft fuel are: particulates, sulfur dioxide, carbon monoxide, hydrocarbons, and nitrous oxide. These pollutants also combine and react with emissions produced by pollutants produced by automobiles. To protect the surrounding area from these undesirable effects, the land use plan must seek to provide land uses compatible with their associated pollution levels. It is additionally important to prohibit land uses which would compound the effects of air pollution.

Land use policies and controls should provide that no land use sensitive to air pollution should be permitted in areas exposed to high pollution levels. This would include activities involving medical services, children, continuing daily heavy physical exertion, persons with respiratory or circulation problems, leafy vegetables, and ornamental plants.

It is also important not to permit heavy industrial or manufacturing uses which might tend to add to or compound the effects of air pollution caused by aircraft operations.

According to the Environmental Assessment, there will be little impact because of air pollution caused by the airport off of the proposed airport property. The appropriate sections of the Environmental Assessment contain a comprehensive analysis of air pollution impacts. Based upon this analysis, it has been concluded that off-airport land use policies and plans for the areas adjacent to the proposed airport property need not anticipate any significant air pollution impact as a result of aircraft operations.

Flight Safety: Consideration of safety in land use planning for the vicinity of airports should be based on factual data concerning the probability of accidents and also on some evaluation of the risk potential of such accidents. Statistics furnished by the Bureau of Aviation Safety of the National Transportation Safety Board and the analysis prepared by the Air Safety Publications represents a first step in this direction; however, more comprehensive studies are needed.

During the year 1970 there were 4,954 civil aircraft involved in accidents investigated by the NTSB. A total of 672, or 13.5%, occurred outside the airport boundary but within one mile of the airport. The near-airport accident tends to be more severe than the overall accident statistics would suggest. It is about 50% more likely to result in destruction of the aircraft and fatal injuries and about twice as likely to result in fire on impact. From the evidence presented, at least 60% of near-airport accidents are concentrated within rather narrow bands at either end of airport runways.

While the fatality rate is high (a total of 383 persons died in accidents near airports during 1970), only four were not in the aircraft involved. Persons on the ground are not injured by falling aircraft unless they are in the impact area. Only when the pilot is given no alternative will he bring the aircraft down in an inhabited area. Finally, the greatest percentage occurrence by type of operation is in the personal and business flying which provides 63.5% of the near-airport accidents.

Most general aviation aircraft enter the final approach path from 2,000 to 3,000 feet off the ends of the runways; commercial aircraft enter the approach path from seven to ten miles off the end of air carrier runways during an instrument approach and three to four miles for a VFR approach. On takeoff, commercial carriers may turn from the path two to three miles from the start of takeoff, whereas general aviation aircraft may make a desired turn within one to two miles.

Existing data and research does not provide adequate information to define specific areas which require flight safety protection. However, as indicated earlier, the areas most likely to experience near-airport crashes are at either end of the airport runways, extending approximately one to two miles out from the end of the runway.

General policies suggested for increasing flight safety are as follows:

- o No land uses, such as hospitals, schools, high-intensity recreational uses, shopping centers, etc., that concentrate large numbers of people in one area should be permitted underneath the departure and final approach paths; and

- o Land uses involving storage or handling of corrosive, explosive, or flammable materials should not be permitted underneath the departure and final approach paths, except where safeguarded and found necessary for airport operations.

Obstruction: Obstruction criteria aimed at the safety and efficiency of airport operations and the protection of on-ground occupants and property, require that land use not impair airspace visibility or communication or otherwise increase the potential or magnitude of plane crashes. The approach, transitional, horizontal, and conical surfaces (zones) for the Sonoma County Airport are shown in Drawing 5, Approach and Clear Zone Plan. The definitions and criteria for these surfaces are contained in the FAA's Federal Aviation Regulations (FAR), Part 77. The existing Airport Zoning Ordinance should be revised to reflect these new surfaces (zones).

With respect to areas directly below these surfaces, no use should be permitted which would:

- o Create electrical interference with navigational signals or radio communications between the aircraft and airport;

- o Make it difficult for pilots to distinguish between airport lights and others;

- Result in glare in the eyes of the pilots using the airport;

- Impair visibility in the vicinity of the airport or otherwise in any way create a hazard or endanger the landing, takeoff, or maneuvering of aircraft intending to use the airport; or

- Permit structures or trees to a height in excess of the applicable height limits established for such zones.

Capacities of Public Facilities: It should be obvious that land use policies and plans should not encourage development which exceeds the existing or planned capacity of utility and transportation systems designed to serve the area. Thus, the land use plan should not permit uses which would overload any of the public service facilities in the area. These include: roadways, water systems, sewer systems, police and fire facilities, etc.

Environmental Suitability: The environmental suitability of land uses with respect to airport impacts and area characteristics is another important policy area. Because the natural environment may be adversely affected by some of these impacts, it is necessary to minimize those impacts and provide against uses that compound them. This involves an understanding of the support requirements and sensitivities of the natural systems in the area affected by the airport; the magnitude, nature, and extent of airport impacts; the physical requirements of specific types of development; and the physical characteristics of the impact area. General policies suggested with respect to environmental considerations are:

- No land uses should be permitted which would compound the nominal environmental impact of the recommended airport plan and airport operations; and

- Sensitive species and habitats should be protected against disturbance by future land use changes and developments.

The Draft Environmental Assessment should be referred to for more detailed discussion of environmental suitability.

Economic and Functional Feasibility: Within the airport environs, land uses should be sought that are economically feasible and functionally compatible with airport development and operations. The economic feasibility of development relates, in part, to the cost of development (including necessary soundproofing or special protection design features), the cost of extending public services to that activity, and the resultant public return through taxes, employment, and other benefits. Efficient land uses, land use patterns, and relationships should obviously be encouraged, and activities that would be more feasible in alternative locations should be discouraged. For example, residential development requiring soundproofing and special landscaping at a cost greater than 10% to 15% of the home's value would not be economically feasible.

In addition to economic feasibility, land use should have functional compatibility with the airport. For example, agricultural use in areas where airport impacts constrain certain types of development, or airport-related uses that support or are oriented to airport operations and that meet established criteria could be located close to the airport. The airport-related uses include such activities as:

- Aviation laboratories and schools
- Aircraft repair and fuel and parts supply
- Airline schools
- Warehousing and air cargo services
- Public aviation planning and administrative offices
- Environmental monitoring and enforcement agencies

- o Aerial survey services
- o Parking lots
- o Transportation terminals
- o Hotels/motels and restaurants
- o Automobile services and rentals.

Recommended Land Use Policies

Existing policies and land use controls in the airport environs are interim in nature, to be applied until the adoption of a new Airport Master Plan.

Current policies guiding land use in the airport study area favor limited development, preservation of agricultural land, and encouragement of airport-related industrial uses adjacent to Airport Boulevard. These policies should be continued as they are consistent with generally accepted airport-related policies designed to minimize airport impacts.

Based on the existing planning goals, other stated public planning objectives, and the proposed Airport Master Plan, the following guidelines are recommended for off-airport land use development within the study area.

- o The Airport Approach Zoning Ordinance should be continued to control man-made and natural hazards to aircraft in the land areas lying within the approach, transitional, horizontal, and conical zones (see Approach and Clear Zone Plan). Modifications to this ordinance, however, are required. The County should amend and re-enact this ordinance to reflect current FAA requirements and to incorporate the new Approach and Clear Zone Plan.

- o Light industrial (industrial park or warehouse) uses should be permitted adjacent to the Airport along Airport Boulevard. Heavy industrial uses which create

excessive noise, vibration, electrical disturbance, electromagnetic interference, air pollution, glare, heat, dust, or involve the use of flammable or explosive materials should not be permitted within this area. The amount of land zoned for industrial use should be directly related to the capacity of existing and planned sewer and water systems and the capacity of Airport Boulevard. The existing traffic capacity of Airport Boulevard is approximately 1,500 vehicles per hour, with projected 1995 airport traffic equal to 890 vehicles per hour (see Roadway and Access Requirements). Based upon these figures and trip generation rates for industrial land uses, the maximum number of acres which could be developed without exceeding the existing capacity of Airport Boulevard would be approximately 60 acres.[1/] This is considerably less than the amount of land currently zoned industrial, approximately 640 acres. Additional industrial development would require widening of Airport Boulevard to four lanes as specified in the County's General Plan.

- Open space and agricultural uses should be preserved and encouraged in the airport environs, as a natural buffer area between the Airport and the surrounding development. This is more important in the areas underneath the departure and final approach paths. Thus, maximum lot size in existing agricultural zones should be as large as practical to reduce residential densities. Residential, office, and commercial zoning should not be permitted within the areas immediately adjacent to the ends of existing and proposed runways.

1/ 8th Progress Report on Trip Ends Generation Research Counts, State of California, Department of Transportation, July 1973.

- The area along Mark West Creek should be protected as a natural waterway.

- The Windsor planning area is somewhat affected by the north approach zone for Runway 14-32 (see discussion of noise, above). The proximity of the approach zone suggests that it would be unwise to extend the Windsor sewer district westward or to permit any westward expansion of urban development. The preliminary Proposed Land Use Map for the Windsor environs basically is compatible with future airport expansion in that it recommends agricultural zoning (five acres minimum lot size) for the area north of the Airport and west of Windsor Road. This preliminary plan basically suggests limiting urban development to land east of the railroad with the exception of a rather large triangular-shaped residential area. It should be noted that a northern extension of Runway 14-32 will not adversely affect this proposed development. The ultimate 30-NEF contour with a northern extension to Runway 14-32 just touches the southern limits of the proposed residential development.

- The Piner-Fulton area, with the exception of the land west of Fulton which is under the approach zone for Runway 14-32, is also outside of the area which would be directly affected by airport operations. Thus, future land use plans for this area should more properly be based upon other planning considerations.

- The area east of the railroad is also outside of the impact area of the Airport and, therefore, development in this area need not be based upon airport-related land use controls.

- The large agricultural area west of the Airport again is largely outside of the limits of airport impacts. However, it is suggested that this area should remain essentially agricultural in nature, primarily because of soils and the flood plain district.

- Existing agricultural uses should be maintained along either side of Slusser and Windsor Roads.

- It is recommended that the County purchase the land extending 5,000 feet out from the ends of the primary surface of Runway 14-32 and Runway 1-19 for a distance of 1,250 feet to either side of the centerline. This land purchase would:

  - Protect the clear zones;
  - Ensure compatible land use development immediately outside the clear zones;
  - Promote flexibility for presently unforeseen runway expansion requirements; and
  - Provide public land which could be developed for recreational purposes.

- The land recommended for public acquisition should be considered for development as future recreational areas. For example, the area within the proposed northern airport boundary could be developed as a regional park serving the needs of the residents in the Healdsburg-Windsor areas.

- The Recommended 1995 Land Use Map (Figure 13) illustrates the proposed generalized land uses for the airport study area. The recommended land uses should be adopted to help protect the Airport and its environs.

RECOMMENDED 1995 LAND USE PLAN

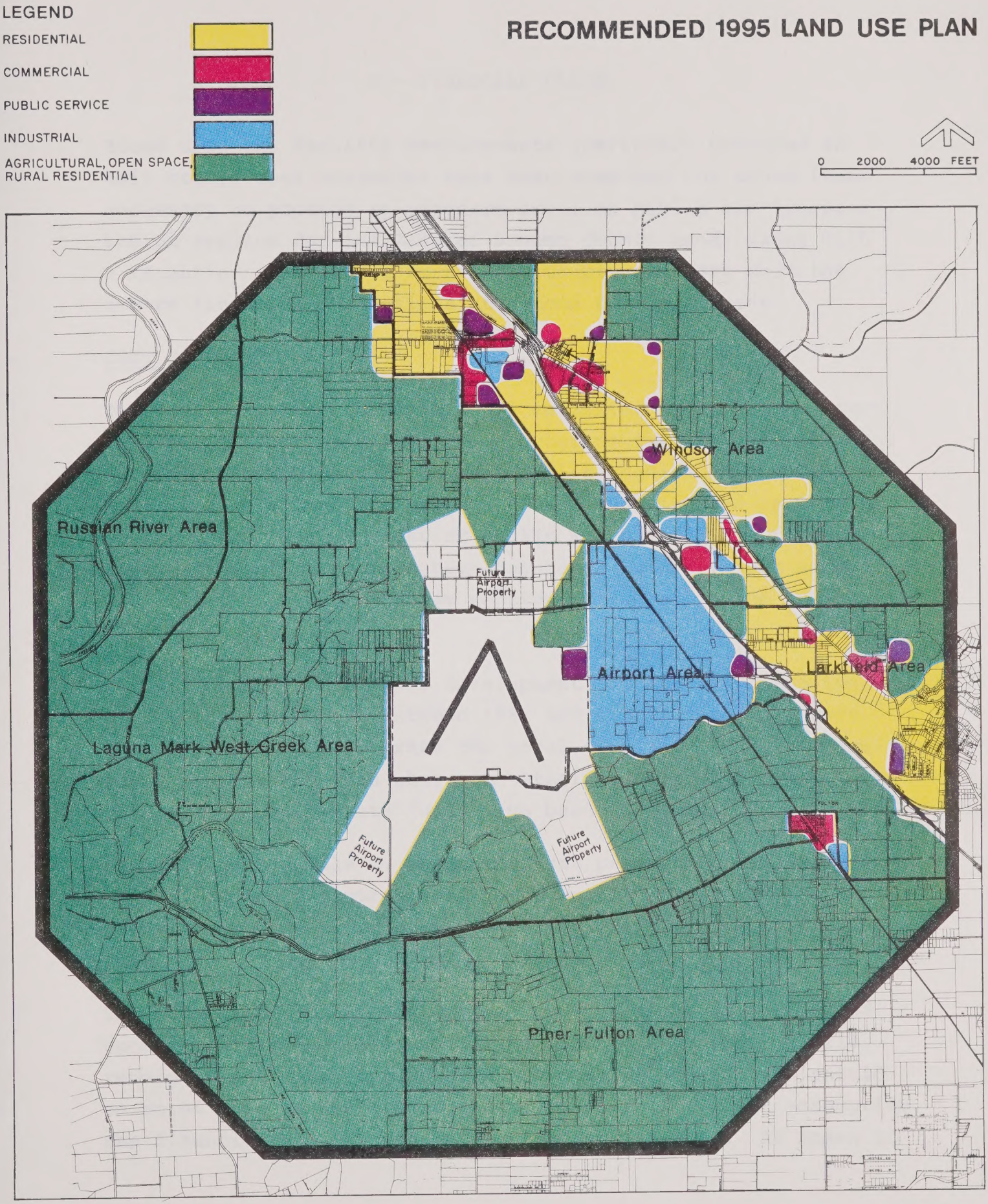


FIGURE 13

X - FINANCIAL PLANS

Based upon the facility requirements previously proposed in this study, cost estimates have been computed for those items necessary to provide an adequate level of public air transportation service for the Greater Sonoma County area, along with a financial analysis as to how the County can best meet the future financial obligations at Sonoma County Airport.

COST ESTIMATES

The costs shown in Schedule A are estimates (based on the current U.S. dollar value) of those programs that the Consultant has determined necessary to meet public requirements. These estimates were developed by the Consultant with the assistance of the County's Department of Public Works and Airport Management. The estimates have been tabulated in two stages consistent with the staging program section presented in the previous chapter.

Stage I covers recommended development through 1980, and Stage II covers development between 1981 and 1985. The costs have been prepared to illustrate the total capital cost of the proposed project and then what each staging would cost the County after Federal and State funds have been deducted.

As shown in Schedule A, the Consultant projects a significant capital outlay for strengthening Runway 14-32 and related taxiways, for constructing storage hangars, and for acquiring land.

The financial planning of Sonoma County Airport is predicated upon the assumption that scheduled commuter air service will remain at the Airport through the projected period. It should be noted that if there is a change in this particular assumption the financial plan should be reviewed accordingly. As shown in

Schedule A, the total long-term improvement costs are estimated to be some $9.8 million, of which some $3.5 million will be the County's share and approximately $6.3 million will be Federal and State aid.

During Stage I, it is estimated that the County's share of improvement costs will be about $1.9 million, with some $4.0 million provided through Federal and State aid for a total Stage I costs of approximately $5.9 million. The Stage II costs to the County are estimated to be $1.6 million; the Federal and State's share is also approximately $2.2 million.

FINANCIAL CONSIDERATIONS

Methods of Financing Airport Capital Improvements

The ultimate goal of any method of airport financial planning should be to achieve sound, economic operation, while providing an adequate level of public facilities and lowering the general taxpayers' burden by developing a maximum financial return from the airport facility.

There is a variety of sources from which financing for airport facilities can be obtained, including the Federal Airport Development Aid Program (ADAP), Federal Revenue Sharing Funds, State aid, private donations, lease-back arrangements, direct revenue loans, and, as in the case of most municipalities, the sale of general obligation bonds and/or revenue bonds. In addition, many capital improvements can be financed from surplus general funds that are provided from annual tax revenues, which is the case at Sonoma County.

General Obligation Bonds: If adequate funds are not available from the general fund, then the sale of general obligation bonds, backed by the taxing power of the community, is generally the most economical method for communities to finance airport development. Proceeds from the sale of general obligation bonds,

however, are not generally available to finance the private-owner, exclusive-operation facilities on a public airport, such as T-hangars and exclusive-use aprons.

Revenue Bonds: Another primary source of airport financing is either the sale of revenue bonds secured by pledge of revenue of some or all of the airport facilities, or a combination of general obligation and revenue bonds guaranteed by the community.

General Fund: Financing airport improvements directly from a municipality's general fund is, of course, the most economical method, since such financing will eliminate any interest payments. However, it should be recognized that financing airport improvements from this source could conceivably place restraints on moneys available from the municipality's general fund to meet normal operating expenses and to provide additional nonairport capital improvements.

Financial Planning

The important factors involved with the success of providing improvements to an airport and limiting the financial burden on the taxpayers are: a carefully organized physical plan (as presented in this report) and the prudent, skillful development of a successful financial plan.

If the County continues its practice of financing its share of airport improvements from the General Fund, the overall airport financial policy should be based upon the premise that any surplus moneys not required to operate the Airport should be refunded to the County's General Fund to help offset the original loan, thereby reducing, to some extent, the taxpayers' burden.

FINANCIAL PLAN - SONOMA COUNTY AIRPORT

The general financial plan of projected income and expenses set forth in Schedules B and C for Sonoma County Airport should be

used by the County as an initial guide for financial planning purposes. Schedule B covers a period of 11 years since the validity of assumptions and accuracy of financial projections beyond that period is questionable. *The County of Sonoma should update and revise periodically Schedule B to correspond with the detailed planning and development of the Airport and current economic conditions.*

Schedule B (Historical and Projected Income and Expenses) is based upon the following factors and assumptions:

1. The dollars projected are based upon the 1975 U.S. dollar value.
2. Scheduled air commuter service will remain at Sonoma County Airport through 1985.
3. Consideration was only given to income from existing nonaviation facilities. (Because of the lack of historical data, income from the Airport's industrial park was not considered.)
4. No additional major capital expenditures other than presented in this report will be required during the forecast period.
5. The forecasts of passenger and aircraft volumes and overall airport activity as projected in this report will be realized.
6. To insure that a maximum financial return to the County is realized and that the County's public service obligations are met, all airport user agreements and contracts will be reviewed and updated periodically.
7. There will be effective and prudent management of the Airport throughout the projected period.

8. The present policy of not making direct expense charges to the airport account for certain services performed by other County departments will continue through the projected period.

9. Capital improvements will be financed to the extent possible with Federal and State funds with the Sponsor's share coming from the County's General Fund.

10. Adequate financial records will be established at the airport level, including an airport cost accounting system. Such financial records will be in a format that they can be used by Airport Management in exercising proper day-to-day and long-term management decisions.

Operating Income - Stages I and II

Airfield Area (Landing and Fuel Flowage Fees): The landing fee income set forth in Schedule B is related to the frequency of scheduled air commuter flights that will be using the Sonoma County Airport. It is anticipated that the increase in frequency of scheduled commuter service, along with the normal adjustments of landing fee charges, will increase some 30% by 1980 from that which is expected by the end of F.Y. 1974 and then increase by some 41% by 1985 over that received in 1980.

The largest source of airfield income will be from fuel flowage fees derived from the sale of aviation fuel to general aviation users. In Fiscal Year 1973, the County received an average fuel flowage income of approximately $0.29 per flight. This increased to some $0.36 per flight by F.Y. 1974. Based upon (1) the forecast of 266,000 general aviation operations by 1980 and 368,000 by 1985 (137,461 operations in F.Y. 1973), (2) normal increases in the fuel flowage rate, and (3) larger and more

sophisticated aircraft which will make up the general aviation fleet, it is anticipated that fuel flowage fee income will increase about 233% over the projected period.

Terminal Building (Airlines, Restaurant, etc.): Revenues from the terminal building and area are derived from two major sources: rentable areas and concessions.

Because of (1) the anticipated expansion of the terminal building facilities during Stages I and II of the proposed capital improvement program, as discussed in other sections of this report, (2) normal increases in passenger activity, and (3) a requirement for a readjustment of scheduled air commuter rental rates, the rental income from the terminal building should increase over the projected period.

Concession income, which is directly related to terminal building activity, can be derived from various sources, such as auto rentals, coin machines, advertising, restaurant, and telephones. Because of the expected increase in terminal building activity, particularly those users requiring rent-a-car and restaurant services, total terminal building concession income should increase modertately over the projected period.

Other Areas (Hangars, Tie-downs, Building, and Ground Rentals): Other airport revenues can be derived from various sources, such as hangars, tie-downs, building and ground rentals, and motels. Because of the anticipated increase in based aircraft to 435 by 1980 and then to 550 by 1985 (254 based aircraft as of June 1973), there will be additional demand through the forecast period for more hangars, T-hangars, and tie-downs. This rental income will continue as in the past to be the single largest source of airport operating income -- averaging some 36% of total operating income through the projected period.

Based upon the proposed long-range development of the airport industrial park, as well as other airport commercial development, Airport Management has projected a substantial increase in ground rental income -- estimated ground rental income by the end of F.Y. 1975 is $12,000, increasing to about $40,700 by 1980 and then to approximately $144,000 by 1985.

Operating Expenses - Stages I and II

Salaries and Wages: Other than the expense of providing capital improvements, one of the major expense items will continue to be salaries and wages covering the labor utilized for the operation of Sonoma County Airport. Because of (1) a new 24-hour County guard/security service, which was formerly contracted out, and (2) normal increases in other airport personnel resulting from a significant increase in airport activity, salaries and wages are expected to increase by 1980 to some $150,000 (56%) over that expected by the end of F.Y. 1975. However, only a 20% increase is expected over the next five-year period.

Other Expenses: The expense of maintaining equipment, structures, and improvements will be required to establish a preventive maintenance program for existing, as well as improved, facilities. As existing facilities depreciate, airport activity increases, and new and improved facilities are provided, maintenance and repair expenses will increase accordingly.

Future Financing

As presented in Schedule C, the County's initial Capital Improvement Program, as part of Stage I, for the continued development of Sonoma County Airport will be some $1.9 million and then increase to some $3.5 million by 1985 (Stages I and II combined).

By using the County's General Fund as a source of financing airport improvements (excluding any interest payments) and by depreciating the investment on a straight-line basis over a 20-year period, there will be an additional annual airport expense of

some $95,400 over the next six years. This would increase to approximately $173,700 by 1985.

CONCLUSIONS

- The Sonoma County Airport will operate with a cash profit during the initial six years of the projected period. Because of anticipated increases in fuel flowage fees and ground rental income, the cash profit of the Airport will increase considerably during the latter projected period (1981-1985), reaching a high of some $243,700 by 1985.
- After depreciation of the proposed airport improvements, the Airport will operate at a small net loss through the 1975-1980 period and then at a small net profit during the ensuing five years.
- Airport operations will not generate sufficient moneys during the initial six-year period to reimburse fully the County's General Fund. Income from airport operations during the Stage II period, however, will be of a sufficient amount to help reimburse the General Fund for moneys expended for airport capital improvements.

It should be recognized that insufficient revenues derived from airport operations to provide moneys for required capital improvements is not uncommon to many publicly-owned facilities. In evaluating the financing program for Sonoma County Airport, the following factors should be considered by the County:

- Additional income obtained from certain County taxes which is not considered as part of the overall airport operating income. Airport Management has indicated that this source of tax income

will amount to an estimated $76,000 by the end of F.Y. 1975, increasing to some $144,000 by 1985 (Schedule B).

- There are approximately 142 airport employees in F.Y. 1975 producing an estimated airport payroll of $1.5 million. By 1985, Airport Management anticipates there will be about 300 airport employees resulting in an airport payroll of some $3.3 million.

The financing program for Sonoma County Airport should not preclude the County from striving to achieve an ultimate goal of operating the Airport in such a manner as to receive sufficient revenues from airport users to recover all operating expenses, financing expenses, and depreciation; to maintain adequate reserves for protection against unpredictable contingencies (e.g., natural forces damage, fire); and to provide for future improvements and capital equipment.

Only by adopting this type of policy can the County provide an adequate level of public facilities and lower the general taxpayers' burden by developing a maximum financial return from the Airport.

RECOMMENDATIONS

In order to insure maximum financial return to the County, it is recommended that:

- All airport user agreements and contracts be reviewed and updated and a policy be established as to future airport leases.
- All airport revenue-producing areas, including the Airport Industrial Park, be developed to the extent possible.

- Present airport financial records be revised in such a manner that Airport Management can use the financial information in exercising day-to-day and long-term management decisions.

- The master plan as presented in this report, as well as the Airport's financial plan, be updated and revised periodically.

SCHEDULE A

CAPITAL COST ESTIMATES
Sonoma County Airport

DESCRIPTION	PROJECT COST	SPONSOR'S SHARE
Stage I (1975-1980)		
Strengthen Runway 14-32 and Taxiways	$ 1,500,000	$ 291,000
New General Aviation Runway and Taxiways[1/]	200,000	19,000
Expand Transient Apron[1/]	310,000	30,000
Construct 70 Tie-Downs[2/]	115,000	22,000
Construct 50 Storage Hangars	800,000	800,000
Expand Terminal Building	200,000	200,000
Fire Station and Maintenance Building	120,000	22,000
Land Acquisition	2,700,000	524,000
Total - Stage I:	$ 5,945,000	$ 1,908,000
Federal and State Share:	$ 4,037,000	
Stage II (1981-1985)		
Land Acquisition	$ 2,700,000	$ 524,000
Construct 50 Tie-Downs	83,000	16,000
Construct 50 Storage Hangars	800,000	800,000
Expand Terminal Building	200,000	200,000
Modify Parking Lot	25,000	25,000
Total - Stage II:	$ 3,808,000	$ 1,565,000
Federal and State Share:	$ 2,243,000	
TOTAL - STAGES I AND II:	$ 9,753,000	$ 3,473,000
TOTAL FEDERAL AND STATE SHARE:	$ 6,280,000	

Notes: 1/ Includes CALTRANS (State) Matching Money.
2/ No cost for fill.

SCHEDULE B

PRO FORMA STATEMENT - HISTORICAL AND PROJECTED INCOME AND EXPENSES
Sonoma County Airport

	HISTORICAL - FISCAL YEARS					PROJECTED[3]	
	1971	1972	1973	1974[1]	1975[2]	Stage I 1975-1980	Stage II 1981-1985
Operating Income							
Landing Fees							
Air Carrier	$ 3,684	$ 2,398	$ 3,803	$ 5,078	$ 7,327	$ 9,500	$ 13,400
Nonscheduled	238	73	--	300	3,083	8,700	10,500
Fuel Flowage Fees	12,258	15,634	19,849	25,216	28,535	61,200	95,000
Terminal Building							
Airlines	5,629	6,555	5,906	6,316	4,165	6,300	9,500
Restaurant[4]	2,285	3,843	6,519	11,644	13,185	20,000	23,500
Hangar/Tie-Down Fees	28,232	33,562	34,325	37,725	54,500	106,000	150,000
Other Building Rentals	9,661	10,132	12,226	10,121	8,128	8,500	9,000
Ground Rentals[5]	7,965	7,043	8,727	9,642	12,006	40,700	144,000
Miscellaneous Income	349	1,258	1,389	1,598	2,900	3,500	5,000
Security Reimbursement	--	--	--	9,463	1,418	--	--
Total Operating Income:	$ 70,301	$ 80,498	$ 92,744	$117,103	$135,247	$ 264,400	$ 459,900
Operating Expenses							
Salaries and Benefits	$ 38,836	$ 45,779	$ 44,290	$ 54,265	$ 96,208	$ 150,000	$ 180,000
Maintenance							
Equipment	327	499	1,597	2,792	3,750	6,500	8,200
Structures and Improvements	5,026	5,641	7,002	9,545	10,200	16,500	24,000
Administrative	2,391	2,786	3,042	5,487	4,760	8,500	12,000
Utilities	4,417	5,539	7,617	8,282	9,400	13,500	18,000
Airline Security	--	--	--	9,463	1,418	--	--
Contractural Security	--	--	--	4,469	4,271	--	--
Miscellaneous Expenses	719	67	60	279	300	500	1,000
Total Operating Expenses:	$ 51,716	$ 60,311	$ 63,608	$ 94,582	$130,307	$ 195,500	$ 243,700
Operating Profit/Loss: Moneys Available to Finance New Improvements:	$ 18,585	$ 20,187	$ 29,136	$ 22,521	$ 4,940	$ 68,900	$ 216,200
Depreciation of Proposed New Improvements Financed from County's General Fund (Schedule C)[6]						$ 95,400	$ 173,700
Net Profit (Loss):						($ 26,500)	$ 42,500
Tax Income In Lieu (on based aircraft)				$ 54,381	$ 63,700	$ 100,000	$ 128,000
Possessory Interest and Personal Property				10,500	12,040	14,350	16,000
Total				$ 64,881	$ 75,740	$ 114,350	$ 144,000

Notes: 1/ Fiscal Year 1974 - Without Audit.

2/ Fiscal Year 1975 - Estimate.

3/ Projections based upon last year of each time period.

4/ Includes Rent-A-Car and Vending Machine Income.

5/ Excludes income from Land Acquisition, Stages I and II.

6/ County's share of new improvements to be financed from County's General Fund and to be depreciated as a cash item over a two-year period.

Source: Airport Management Records and County Auditor-Controller's Office.

SCHEDULE C

DEPRECIATION ANALYSIS OF PROPOSED
CAPITAL IMPROVEMENTS

Sonoma County Airport
Sonoma County, California

Total Capital Cost	Federal and State Funds	Stage I 1975-1980	Stage II 1981-1985	TOTAL SPONSOR'S COST
$ 5,945,000	$ 4,037,000	$1,908,000	--	$1,908,000
3,808,000	2,243,000	--	$1,565,000	$1,565,000
$ 9,753,000	$ 6,280,000	$1,908,000	$1,565,000	$3,473,000

DEPRECIATION

	Stage I 1975-1980	Stage II 1981-1985	TOTAL
Straight Line Depreciation - 20-Year Period	$ 95,400	$ 95,400	$ 95,400
	--	78,300	78,300
	$ 95,400	$ 173,700	$ 173,700

Note: Depreciation on annual basis for each time period.

ENVIRONMENTAL ASSESSMENT

appendix A

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APPENDIX A - ENVIRONMENTAL ASSESSMENT

DESCRIPTION AND PURPOSE OF THE PROJECT

Description of the Project

The Master Plan for Sonoma County Airport, presented in previous sections of this report, will involve two types of activities: (1) those which will have an environmental impact and will be generally discussed in this assessment, and (2) smaller scale activities which will not have an identifiable impact. In the case of the latter, the information contained in this Appendix represents the necessary background data to permit a decision of no significant environmental impact.

There are three actions which will be discussed in this assessment:

1. Land Acquisition: The Master Plan calls for the acquisition of 580 acres south of the Airport and 395 acres north of the Airport. This property is required to protect existing and proposed clear zones as well as to insure future land use compatibility. Approximately 75 residences to the north and 7 residences to the south may be involved.

2. General Aviation Runway: It is recommended that a 3,200-foot by 75-foot general aviation runway and supporting taxiway, parallel to and 1,400 feet west of existing Runway 14-32 be constructed. This project would be entirely within the Airport boundaries and would involve the paving of slightly over 7 acres that is presently unpaved.

3. Runway Extension: The Plan allows a 1,000-foot runway extension to either Runway 14-32 or Runway 1-19. This project would involve the paving of between 4.5

and 6 acres of land, depending upon the actual location of this extension. If the 1,000-foot extension is to the north, approximately one-half to three-quarters of a million cubic yards of fill would be required, the extension would cross the drainage creek just north of the runway and would place aircraft activity nearer the Windsor development. If the extension is to the south, the clear zone will affect Mark West Creek, require the relocation of Laughlin Road, and affect a small reservoir south of the runway. If the extension is 500 feet at both ends of the existing runway, the drainage ditch north of the Airport will not be affected and Laughlin Road will not require relocation. A southerly extension to Runway 1-19 would have very insignificant physical impacts.

These projects are graphically presented in Chapter VIII, Drawing 4, Airport Layout Plan.

In addition to these projects, there will be smaller scale projects, such as expansion of airplane parking area, changes in the fuel depot system, installation of NAVAIDS, terminal building expansion, etc. These activities will not be treated specifically in this assessment.

In evaluating the depth of analysis attained in this assessment, the staging of the actions is very important. Project 2 (General aviation runway) is the most imminent of the proposed actions. It is anticipated that the construction of the proposed parallel runway will commence within the next two years. The land acquisition and control program should begin immediately, but due to the magnitude of the project and the funds which are expected to be available, it will be necessary to phase this project over a ten-year period. The proposal to increase the runway length at Sonoma County Airport has not been staged due to the many external variables involved in its justification. This assessment,

therefore, is intended to serve as a base for more detailed environmental analyses (if required) at the time when the proposed actions are implemented.

Purpose of Project

The purpose of the projects outlined above is to provide for the development of facilities required to meet the anticipated aviation demand within Sonoma County during the forecast period (1995).

Project 1, involving land acquisition, is necessary to protect the existing approaches to the Airport and to provide flexibility for the implementation of Projects 2 and 3. Most of the 580 acres in the southern acquisition zone and the entire 395 acres north of the Airport are necessary to meet existing clear zone and land use compatibility deficiencies. The additional acreage in the south zone is necessary to provide flexibility for Projects 2 and 3.

Project 2 proposes the construction of a general aviation runway parallel to Runway 14-32. The purpose of this runway is to provide additional airfield capacity. The existing airfield capacity is approximately 275,000 annual operations, and demand is projected to reach this level by 1980. The construction of this runway will add some 100,000 operations to the capacity of the Airport. This additional capacity will allow Sonoma County Airport to reach a maximum activity level of approximately 400,000 operations, which will accommodate airport users until the late 1980's.

Project 3 recommends increasing the length of either Runway 14-32 or Runway 1-19 to 6,000 feet. This additional runway length may be required to satisfy the demands of increasingly sophisticated general aviation aircraft that will be using the Airport, as well as provide adequate runway length for any future air carrier service.

In 1974, the U.S. Forest Service began operating DC-6 aircraft as aerial chemical bombers to fight forest fires throughout northern California. Because of the rapid commercial and industrial development within Sonoma County, there has been an increased utilization of the Airport by sophisticated business jet aircraft. Virtually all of the demand by the Forest Service, as well as a large portion of the business jet demand, occurs in the hot summer months, which increases the need for runway length. In times when the temperature results in a demand for runway in excess of 5,100 feet, aircraft will be forced to off-load either payload or fuel, or wait until the temperature decreases. Either or these options results in inefficient operations.

Growth Inducement

The projects outlined in this report are not considered to be growth inducing, but rather projects intended to satisfy demands for aviation facilities within Sonoma County. The programs are intended to provide present and future users of the Airport with continued safe and efficient aviation facilities. None of the proposals will induce a change in the population trends within the County or alter the development of property in the vicinity of the Airport. The construction of a parallel runway will allow more aircraft to operate from the Airport; however, these are aircraft that otherwise would be operated at other facilities in the area or at the County Airport in an overloaded and inefficient condition. If the runway length was increased to accommodate scheduled flights to Southern California, travelers who would normally commute to San Francisco in order to fly south would now be afforded direct access. This type of program is intended to meet existing and projected demand and not to induce latent demand.

Master Plan Summary

Summary - Air Trade Area and Socioeconomic Analysis: The area served by Sonoma County Airport has been categorized into two

areas: one for general aviation activity and one for commercial air services.

Because of the availability of general aviation airports in Sonoma County, general aviation activity at the Airport is for the most part generated by residents of the City of Santa Rosa and vicinity (which includes Healdsburg and Sebastopol). Consequently, it is this area that has been defined as the general aviation air trade area. This was concluded from an analysis of the County Assessor's records of aircraft owners and from the results of a survey of airport users conducted by the Consultant.

The results of a survey conducted by Sonoma County of airline passengers using the Airport showed that over 95% of the passengers resided in Sonoma County; therefore, the Primary Air Trade Area for scheduled air service is defined as Sonoma County. It is acknowledged, however, that some scheduled airline passengers travel to and from the adjacent counties of Mendocino, Lake, Napa, and Marin.

Some of the more important socioeconomic factors affecting the demand for air transportation services and facilities are income distribution, employment, the level of industrial development within the area served by an airport, and population. An analysis of these factors within Sonoma County is contained in Chapter IV of this Master Plan Report. As a result of this analysis, it was determined that demand for air transportation services and facilities at Sonoma County Airport will increase at a rate in excess of the national average.

Summary - Historical Aviation Activity: Prior to January 1969, Sonoma County Airport had been served by a single scheduled air carrier (Pacific Airlines which subsequently became part of a merger that is now Hughes Airwest). Since that time, third-level air carrier services were available in Sonoma County. Golden West Airlines operated out of Coddington Airport, located in downtown

Santa Rosa, from January 1969 through December 1971, when Coddington Airport closed and the airline then moved its services to Sonoma County Airport. In March 1969, Golden Pacific Airlines, another third-level carrier, initiated service at Sonoma County Airport. In September 1972, both of these carriers ceased services at the County Airport. During the same month, STOL Air, Inc., commenced feeder/commuter operations at the Airport.

Passenger enplanements at Sonoma County Airport had a positive growth through the 1962-1968 period (from 2,280 in 1962 to 4,556 in 1968). A pronounced growth occurred in 1969 (15,452) but there have been fluctuations since that year caused by the introduction and then cancellation of scheduled commuter services, as well as the curtailment of single-plane service by Airwest to many cities. During 1973, 8,551 passengers were enplaned at the Airport.

General aviation activity at Sonoma County Airport has experienced significant growth both in local and itinerant operations. Local operations are those that (1) operate within the local traffic patterns, (2) remain within a 20-mile radius of the control tower, or (3) execute simulated instrument approaches or low passes at an airport. Itinerant operations are all operations other than local. From 1963 through 1973, local operations grew from 8,759 to 61,514 and itinerant operations increased from 17,948 to 75,947. In the past few years, local operations have become a greater percentage of the total of the two categories.

The number of civil aircraft based at Sonoma County Airport has been increasing at a very significant rate with the greatest growth occurring in the smaller, single-engine type aircraft used for business and pleasure purposes. There has also been a marked increase in the number of sophisticated multi-engine aircraft at the Airport.

Summary - Aviation Demand Forecasts: Forecasting of air passenger traffic at Sonoma County Airport is a very complex process involving

a number of interrelated factors (i.e., possible development of a new regional airport and proximity to San Francisco and Oakland airports). Forecasting methodology and assumptions are outlined in Chapter V of the Master Plan Report. Table 13 (Chapter V) presents the aviation forecast summary for the Airport.

ENVIRONMENTAL SETTING OF THE PROJECT

Nearby Communities and Land Use

The boundaries of the off-airport land use study area (sometimes referred to as the airport environs) define an octagonal region covering approximately 2.5 miles in every direction from Sonoma County Airport. Current land use characteristics and trends within this study area provide the context for formulating policies and plans that will guide and coordinate compatible land use activities and maintain environmental quality in the airport vicinity.

The study area is an unincorporated area under Sonoma County jurisdiction. The southeast half of the study area is within the Sphere of Influence of the City of Santa Rosa, as adopted by the Local Agency Formation Commission, and therefore is included in all major Santa Rosa General Plan studies. Although the study area is essentially rural in character -- a mix of open space, agricultural, and dispersed rural development -- the lands east of the Northwestern Railroad tracks are becoming an urban corridor between the Larkfield and Windsor areas. A detailed description of land uses in the vicinity of the Airport is presented in Chapter IX. The following provides additional summary land use information.

In conjunction with the U.S. Geological Survey, Sonoma County compiled a land use survey based on aerial photographs taken in 1971. This information provides a very good regional perspective concerning land uses within the County. These land uses areas were divided into two main categories (urban and non-urban) with various subgroups within each, as noted in the following listing.

URBAN	NON-URBAN
Industrial/Commercial	Agricultural with residence
Transportation	Non-urban industry
Nonagricultural residential	Open Space
Open Space	Wetland
Water	Livelihood/nonagricultural
	Other native vegetation/Water

Industrial includes manufacturing, canneries, and a sewage disposal plant, and occupies 2,447 acres, or 1/4 of 1%. Transportation activities use approximately 1/8 of 1% of Sonoma County's available land. Commercial, cultural, and recreational account for 65/100 of 1%. Nonagricultural residential, and single- and multi-family residential use 524, 17,684, and 233 acres, respectively, for a combined total of 1.91%. Open space and water occupy 81/100 of 1%. Agricultural with residence (field crop, vineyard, orchard, and pasture) and livelihood/nonagricultural use 40.3% of the County, or 388,385 acres. Of this total, 387,985 acres are found within agricultural with residence. The remaining categories account for 56.17%, or 541,304 acres, of which native vegetation (brush, timber, swamp, and forest) comprises 522,085 acres, and wetlands utilize 11,359 acres.

Much of the land in the airport study area is devoted to agricultural uses, especially to the north of the Airport. To the east, there are some small industries, highway maintenance department yard, pasture, and additional abandoned agricultural land. South of the Airport, there is some cropland and more vineyards. West of the Airport, there are some small ranchettes, pasture and orchards. In the County generally, the agriculture consists of intensive farming for fruit and nut crops, hay and pasture, as well as livestock production. The most widely-recognized crops are, of course, those which come from vineyards and orchards (i.e., prunes, grapes, pears, and apples). In 1972, cattle food, either from hay or pasture, was the category of greatest production in the field crops, while the greatest production of fruits was in grapes, followed by prunes and apples.

Climate

Sonoma County's climate is characterized by moderate temperatures and precipitation (see below). The majority of precipitation occurs during the six colder months of the year, while scattered amounts are reported during the remainder of the year. Annual precipitation generally increases with elevation and the greatest precipitation is in the northern part of the County. The summer dry period is lengthy enough to deplete stored moisture in soils and thus retard plant growth.[12] The following tabulation is a breakdown of 1972 temperature and precipitation data from the Santa Rosa weather station.

TEMPERATURE AND PRECIPITATION
SONOMA COUNTY
(Figures in Degrees Fahrenheit and Inches)

	Temperature					
Month	Highest	Average Highest	Average	Average Lowest	Lowest	Average Precipitation
Jan.	71	57.3	46.5	35.7	17	6.02
Feb.	81	61.8	49.9	37.9	21	5.15
Mar.	88	66.3	52.8	39.2	26	3.98
Apr.	95	70.4	56.0	41.5	28	2.33
May	104	74.7	59.9	45.0	31	.98
June	109	80.5	64.5	48.5	37	.32
July	109	83.7	66.8	49.8	40	.02
Aug.	106	83.6	66.4	49.2	40	.06
Sept.	108	83.9	66.1	48.2	34	.27
Oct.	103	77.4	61.0	44.6	26	1.54
Nov.	91	67.6	53.2	38.8	24	2.94
Dec.	79	58.6	47.8	37.0	15	5.64
Year	109	72.2	57.6	43.0	15	29.95

Source: U.S. Department of Agriculture, 1972 Climate in Soil Survey. Data complied from records at the Santa Rosa Weather Station of the National Weather Service in Sonoma County, California.

The warmest region in Sonoma County is generally in the Russian River Valley in the northern section of the County, with mean temperatures ranging from approximately 53°F in the winter to 55°F in late summer and early fall. Air temperatures remain cool in early summer, with the warmest temperatures occurring during the latter part of summer or early fall. Temperatures of over 100°F have been recorded at all inland stations and temperatures of 112°F or higher have been recorded at several other weather stations in the County.

Winters are generally mild, although cold spells do occur. The mean minimum temperature in January is approximately 42°F in the coastal regions and about 32°F at the higher elevations, although a low of 14°F has been recorded in the higher mountain areas. Average low temperatures throughout the central part of the County range from 15°F to 20°F, while along the coast the low temperature range is from 28°F to 30°F. In January, the daily mean maximum temperature ranges from 57°F at lower elevations to about 55°F in the mountains.(12).

The average date of the last frost in spring occurs most often during the month of March in most cultivated areas while it is often as early as February 1 along the coast and as late as April 15 in the higher elevations. The first frost usually occurs in mid-November in most of the County, early November in the mountains, and after December 21 in the coastal areas.(12)

The growing season ranges from 230 to 260 days in the central part of the County to as little as 200 days in the mountains and as much as 365 days along the coast.(12)

The average seasonal precipitation ranges from less than 20 inches in the extreme southeastern corner to 30 to 40 inches throughout the central sector. At higher elevations in the

northwestern areas of the County, the total precipitation is more than 70 inches and greater than 80 inches in the northeastern areas; however, total precipitation varies from year to year.

Relatively small amounts of snow fall on most of the County; average snowfall at low elevations is less than 1 inch annually, whereas the yearly average at higher elevations is 5 inches (over 25 inches fall in areas of high elevations in the northeastern section annually).

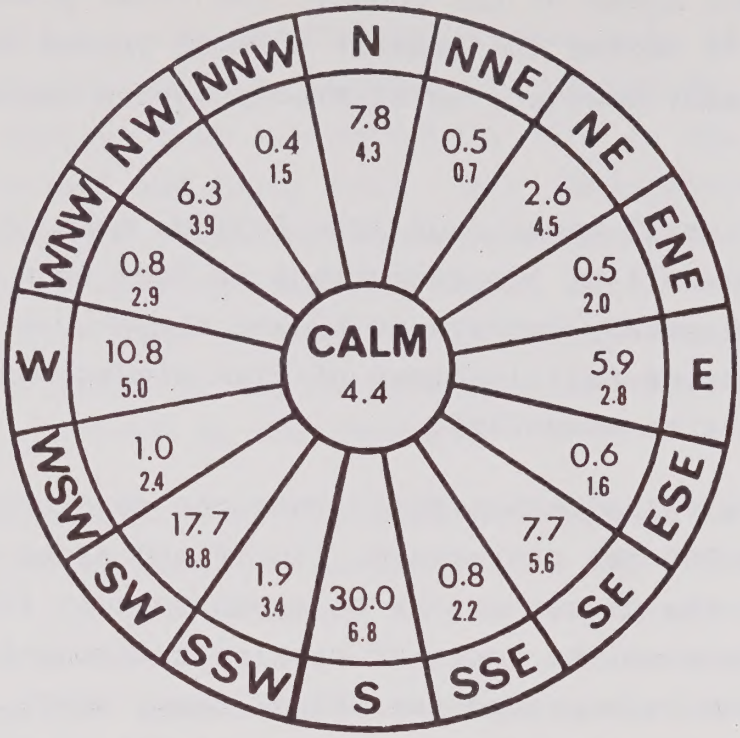
The average relative humidity along the coast undoubtedly remains near 80% the year round. In inland areas it ranges from 75% during the winter months to approximately 60% the rest of the year between the hours of sunrise and sunset. In summer, sunshine can be expected for 80% of these hours in inland areas. Along the coast, however, no more than 60% of the hours between sunrise and sunset can be expected to be sunny.

Winds are typically out of the south-southeast (Figure 1) and are generally light though persistent during summer months, especially in the coastal regions.

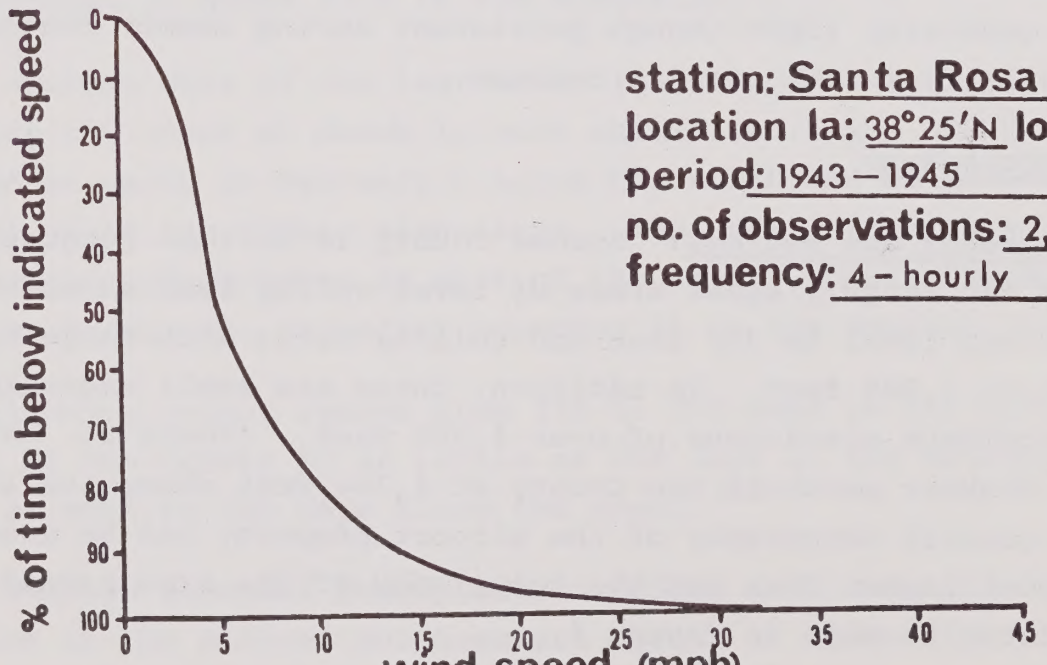
Geomorphology

Topography and Geology: Sonoma County is divided geographically into two roughly equal areas of level valley land at elevations from sea level to 300 feet and rolling hills that range from 300 feet to 1,000 feet. In addition, there are small mountains that approximate elevations of over 4,000 feet. (Mount St. Helena is the highest point in the County at 4,344 feet above sea level.) The general topography of the airport property can be seen in the Airport Layout Plan and the topography of the area around the Airport can be seen in Figure 4.

With coastal plains on the west, the County is divided northwest to southeast by valleys which are generally in the east central



percentage distribution of wind directions with mean wind speed beneath



cumulative wind speed distribution

station: Santa Rosa
location la: 38°25'N **lo:** 122°45'W
period: 1943—1945
no. of observations: 2,010
frequency: 4 - hourly

WIND DATA FOR SANTA ROSA

FIGURE 1

area of the County. Rolling hills surround the valleys and are mainly in a large section in the southwestern part of the County.[5, 13]

The northwestern quarter of the County between the Pacific Ocean and Russian River Valley is mountainous. These mountains extend along the eastern boundary of the County, from the Mendocino county line to about six miles north of San Pablo Bay.[13]

One physiographic influence of major import in the County is the San Andreas Fault and Fault Zone. The fault passes through Bodega Bay and Bodega Head reentering the Pacific Ocean and following a submerged course to the vicinity of Fort Ross, where it once again contacts land. The fault travels in a long, northwest trending valley into Mendocino County, leaving its terrestrial path near Point Arena. The fact that this fault zone exists and partially resides in Sonoma County indicates the youthfulness and constant dynamic activity within the region. This fracture moves about two inches each year. The land west of the fault is moving northward relative to that on the east.

As with most of the County's physiographic features, the valleys (Alexander, Cotati, Petaluma, and Sonoma) trend northwest-southeast. Progressing in a north-south direction, there is a widening of the valleys in the area between Windsor and north of Cotati on the south. The widths of the particular valleys apparently are controlled by the presence of weak rock strata and faulting.

Situated west of the Santa Rosa plain, directly east of the low lying hills of Sebastopol, the Laguna wetland extends for about 10 miles in a northwest-southeast direction. Physiographically, the region is important as a water recharge and storage area, in addition to providing a spillover flood zone area.

Soils: The U.S.D.A. Soil Conservation Service (in cooperation with the University of California's Agricultural Experiment Station) has conducted and completed a soil inventory to determine the location of the various soil types, their use and significance to the County of Sonoma.(13)

The General Soil Map (Figure 2)[1/] delineates soil types found in the general vicinity of Sonoma County Airport, with the Huichica series making up the majority of the area. The Zamora series is the other dominant soil type; the Yolo series encompasses the remainder of the area and is the least significant in occurrence. The composition and characteristics of these series are discussed in the following text. Soil properties, map symbols, and estimated engineering interpretations are delineated on Table 1.

Huichica Series - The Huichica series consists of moderately well-drained and somewhat poorly drained loams that have a clay subsoil. These soils are on hummocky plains and terraces west and northwest of Santa Rosa and in the vicinity of the town of Sonoma (slopes 0%-15%). In uncultivated areas the vegetation is chiefly annual and perennial grasses, forbs, and scattered oaks. The Huichica soils are associated with the Clear Lake, Haire, Wright, and Zamora soils.

Huichica soils are used mainly for dryland and irrigated pasture and for hay crops. A few areas are used vor vineyards and prune orchards. Huichica loam (HtC, 2%-9% slopes) is similar to Huichica loam (0%-2% slopes) but the clay or hardpan substratum may be a few inches nearer the surface.

1/ Map Symbols and Description, Figure 2.

CnA-Cole silt loam; CsA-Cortina very gravelly loam; HtA-Huichica loam, 0%-2% slopes; HtC-Huichica loam, 2%-9% slopes; HtD-Huichica loam, 9%-15% slopes; HuB-Huichica loam ponded, 0%-5% slopes; HvC-Huichica loam shallow, 0%-9% slopes; HwB-Huichica loam shallow ponded, 0%-5% slopes; PbB-Pajaro gravelly loam; RnA-Riverwash; SkE-Spreckles loam; YnA-Yolo loam, 0%-2% slopes; YoB-Yolo loam, overwash, 0%-5% slopes; YsA-Yolo silt loam, 0%-2% slopes; ZaA-Zamora silty clay loam, 0%-2% slopes.

GENERAL SOIL MAP

(AIRPORT VICINITY)

FIGURE 2

Table 1

SOIL PROPERTIES IN THE VICINITY OF SONOMA COUNTY AIRPORT

	Soil Series and Map Symbols		
	Huichica: HtA, HtC, HtD, HvC	Yolo: YlA, YmB, YnA, YrB, YoB, YsA, YtA	Zamora: ZaA, ZaB
Suitability as Source of Topsoil:	Good to depth of 23": loam. Poor below 23": clay.	Good for YnA/YrB/YsA: loam & silt loam. Fair to depth of 15": sandy loam, gravelly loam, & clay lowm. Good below 15": loam.	Fair to depth of 55": clay loam. Poor below 55": gravelly clay.
Suitability as Source of Road Fill:	Fair to Poor	Fair to Poor	Fair to Poor
Road Location:	0%-15% slopes; high shrink-swell potential below depth of 23".	Most features favorable	High shrink-swell potential below depth of 55".
Soil Features Affecting Water Retention -- Embankments:	Fair to poor strength; medium compressibility; poor to good resistance to piping.	Fair to poor strength; medium compressibility; poor to good resistance to piping.	Fair to poor strength; medium compressibility; fair to good resistance to piping.
Soil Features Affecting Water Retention -- Reservoir Area:	Very slow permeability; 0%-15% slopes.	Moderate permeability; 0%-5% slopes.	Moderately slow permeability; 0%-5% slopes.
Soil Features Affecting Agricultural Drainage:	Very slow permeability.	Drainage not needed.	Drainage not needed.
Irrigation:	Moderate available water capacity; moderate intake rate; 0%-15% slopes.	High Available water capacity; moderate intake rate; 0%-5% slopes.	High available water capacity; slow intake rate; 0%-5% slopes.
Depth to Bedrock or Hardpan:	2-3.5 Feet	5 Feet	5 Feet
Classification - Dominant USDA texture:	0-23 Inches from Surface (Typical Profile): loam & sandy clay loam. 23-30 inches: clay. 30-60 inches: strongly cemented hardpan.	0-60 Inches from Surface (Typical Profile): loam (sandy loam, gravelly loam, silt loam & clay loam surface layers present in places).	0-55 Inches from Surface (Typical Profile): clay loam & sandy clay loam. 55-60 inches: gravelly loam.
Permeability: (inches/hour)	0-23 Inches from Surface: 0.63-2.0 23-60 inches: 0.06	0-60 Inches from Surface: 0.63-2.0	0-60 Inches from Surface: 0.2-0.63
Available Water Capacity: (Inches/inch of soil)	0-23 Inches from Surface: 0.16-0.18 23-30 inches: 0.04-0.06	0-60 Inches from Surface: 0.16-0.18	0-55 Inches from Surface: 0.19-0.21 55-60 inches: 0.12-0.14
Reaction: (pH value)	0-23 Inches from Surface: 5.1-5.5 23-30 inches: 5.6-6.0 30-60 inches: 7.4-8.4	0-60 Inches from Surface: 0.16-0.18	0-55 Inches from Surface: 6.1-7.3 55-60 inches: 6.6-7.3
Shrink-swell Potential:	0-23 Inches from Surface: moderate 23-60 inches: high.	0-60 Inches from Surface: Low to moderate.	0-55 Inches from Surface: moderate 55-60 inches: high.

Source: U.S. Forest Service, U.S. Department of Agriculture, Soil Survey - Sonoma County, 1972.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The effective root depth is 20 to 30 inches. This soil is used mainly for prune orchards, grapes, and pasture. Huichica loam (HtD, 9%-15% slopes) is similar to Huichica loam (0%-2% slopes) but up to 15% by volume may be water-washed gravel. The soil occurs primarily in the northwestern Santa Rosa plains adjacent to the Laguna. Runoff is medium and the hazard of erosion is moderate. The available water capacity is about 2 to 4 inches. The effective rooting depth is 12 to 24 inches. This soil is used mainly for pasture, although some areas are used for growing grapes and prunes. The Huichica soils are associated most closely with the airport projects.

Zamora Silty Clay Loam (ZaA, 0%-2% slopes) - This nearly level soil is on alluvial and flood plains. Permeability is moderately low in the subsoil of this Zamora soil. Runoff is slow, and the hazard of erosion is negligible. The available water capacity is 11 to 13 inches; fertility is high. This soil is used mainly for orchards, vineyards, and pasture. Row crops are also grown.

Yolo Series - The Yolo series consists of well-drained loams underlain by recent alluvium from sandstone and shale. These soils are on alluvial fans and flood plains and are mainly in the valley areas along the Russian River and Dry Creek channels. Slopes are 0% to 5%. Where not cultivated, vegetation is chiefly annual and perennial grasses, forbs, shrubs, wild berry vines, and scattered oaks. The Yolo soils are associated with the Zamora soils.

Yolo soils are used primarily for orchards, vineyards, and row and truck crops, while many irrigated areas are used for hay crops and pasture. Yolo loam (YnA, 0%-2% slopes) is nearly level soil in alluvial fans. The slight slopes are very long and smooth.

Permeability is moderate, runoff is slow, and the hazards of erosion are minimal. Fertility is high and the available water capacity is 9 to 11 inches. It is used mainly for prune orchards and vineyards and other types of orchards, row crops, and pasture.

Engineering Uses of the Soils: Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, runways, pipelines, the foundations of buildings, facilities for storing water, structures for controlling erosion, drainage systems, systems for sewage disposal, etc. The properties most important to the engineer are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, available water-holding capacity, particle size, plasticity, and reaction. Also important are depth to water table, depth to bedrock, and relief. Table 1 lists the soil series in and adjacent to the Airport and the map symbols for each mapping unit and gives estimates of soil properties significant to some engineering work.

Geological Resources

Minerals: Sonoma County has a significant mineral wealth, especially quicksilver, sand, gravel, and geothermal power. These resources are shown in Figure 3 in three categories.

- Construction materials which are primarily sand and gravel in deposits scattered throughout the County, especially in the Russian River and Dry Creek areas. Sonoma County supplied more than 13% of the Bay Area's sand and gravel in 1969. Other construction materials include crushed and broken stone, flagstone, limestone, and clay.

- Minerals which include the diatomite deposits, unexploited perlite deposits, and the quicksilver resources from the western Mayacama Mountains and Guerneville.

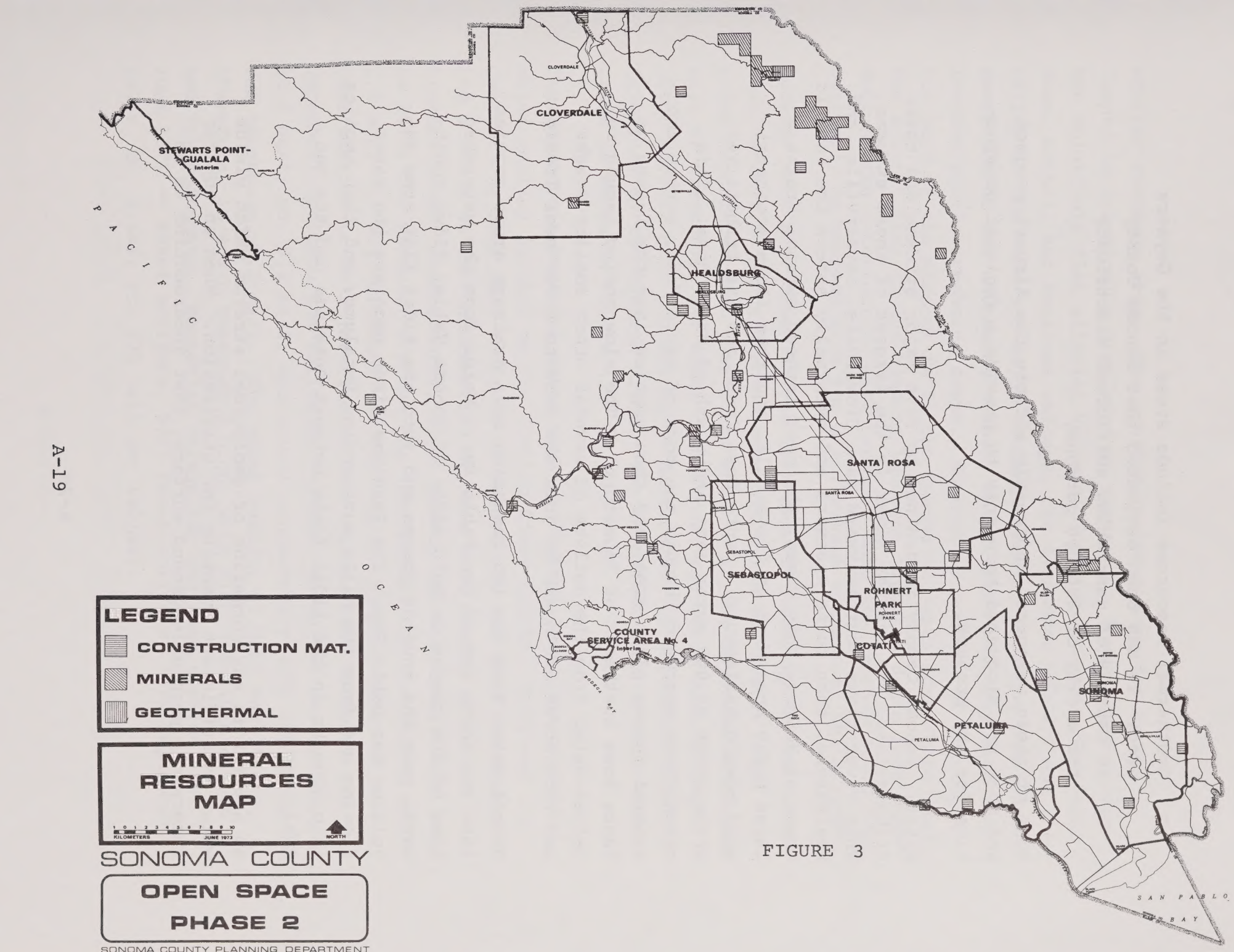

CLOVERDALE
CLOVERDALE
STEWARTS POINT-
GUALALA
Interim
HEALDSBURG
SANTA ROSA
SANTA ROSA
SEBASTOPOL
SEBASTOPOL
ROHNERT
PARK
ROHNERT PARK
COTATI
COUNTY
SERVICE AREA No. 4
Interim
SONOMA
PETALUMA
PETALUMA
PACIFIC
OCEAN
SAN PABLO
BAY
LEGEND
CONSTRUCTION MAT.
MINERALS
GEOTHERMAL
MINERAL
RESOURCES
MAP
KILOMETERS
JUNE 1973
NORTH
SONOMA COUNTY
OPEN SPACE
PHASE 2
SONOMA COUNTY PLANNING DEPARTMENT

FIGURE 3

- Geothermal resources include steam in the Geysers area. It has been estimated that Sonoma County is capable of generating sufficient electricity for a city of 800,000 persons.

None of these resources apparently affects the Airport project and they are discussed here only to provide a regional perspective for the project.

Water: Sonoma County is drained by five major streams and their tributaries. The Russian River is the largest of these streams. This river flows southeastward past Cloverdale, Geyserville, and Healdsburg, then turns westward and eventually enters the Pacific Ocean at Jenner. Dry Creek, the next largest stream, drains a large hilly area west of Cloverdale, and then flows southeastward toward Healdsburg. Santa Rosa Creek and its tributaries drain about 50,000 acres east and south of Santa Rosa. This creek flows westward through the town of Santa Rosa, across the central Sonoma plain area, and then empties into the Laguna de Santa Rosa northeast of Sebastopol. The slow-moving Laguna receives water from the outlets of several other smaller creeks and then moves northward to join the Russian River near Trenton.

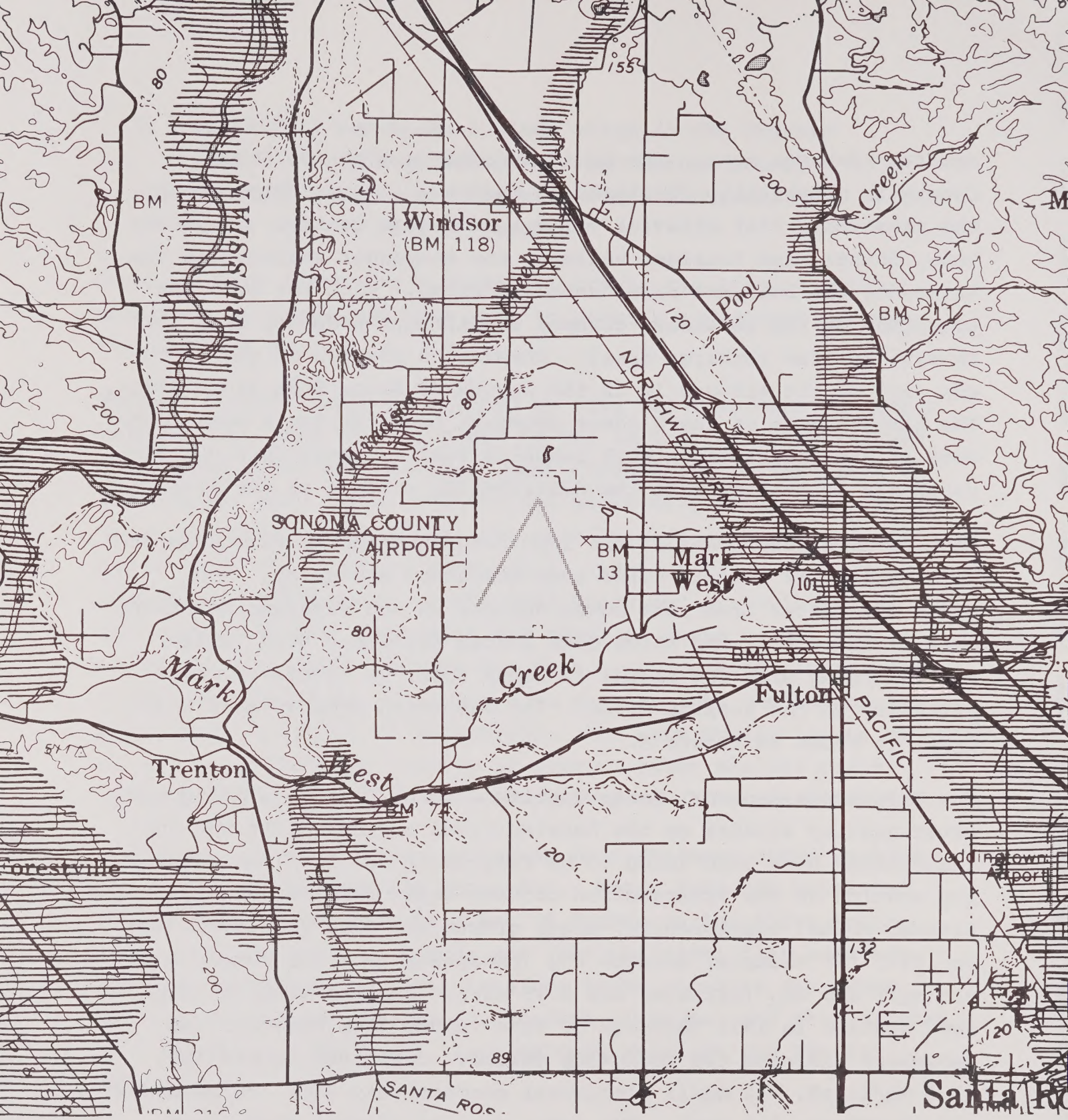
Runoff water from the two remaining main drainage areas empties into the north end of San Pablo Bay. Water from the watershed area of the ranges on both sides of Sonoma Valley flows southward, past the town of Sonoma and into the tidal flat area adjoining San Pablo Bay. The Petaluma River receives the water flowing out from the hills surrounding Petaluma, and then empties into sloughs in the tidal flats between Petaluma and the San Pablo Bay.

An aquifer is any formation or geological stratum which yields water in sufficient quantity for utilization. When an aquifer intersects permeable ground surface, that intersection is an

aquifer recharge area. The aquifer recharge area for Sonoma County is graphically displayed in Figure 4. These areas occupy the relatively flat alluvial valleys of Sonoma County. The Santa Rosa, Cotati, and Petaluma valleys, the Alexander Valley, and the Valley of the Moon are major recharge areas. With the possible exception of the southeast corner, the Airport property does not involve aquifer recharge areas. However, a portion of the northern part of the Airport is in the Laguna de Santa Rosa flood plain. The Airport line of the Windsor Aqueduct taps the Santa Rosa Aqueduct at the intersection with Laughlin Road and extends 2,000 feet northerly to connect with the distribution systems at the Airport.

Because Mark West Creek is the last natural waterway in the Santa Rosa Valley, it has attracted some attention and study. The creek originates from year round springs in the Mayacama Mountains east of Santa Rosa and flows down across the Santa Rosa Valley. After merging with the Laguna de Santa Rosa, it becomes a major tributary to the Russian River. The watershed area of Mark West Creek is shown in Figure 5.

The California Regional Water Quality Control Board has conducted water quality studies on the Russian River system. Nutrient concentrations have been found to be relatively low from one sampling station at the intersection of Mark West Creek, River and Slusser Roads; consequently, algal growth was also relatively low. In 1973, for example, average PO_4 (phosphate) for the summer was 2.5 mg/l and NO_3 (nitrate) was 0.15 mg/l. Samples taken at the same station in 1972 (average of five values from November and December) indicate the following values: dissolved oxygen (DO), 11.0 mg/l; pH, 8.2 mg/l; electrical conductivity (EC) 190 Hmhos/cm; and phosphate, 0.3 mg/l. The water quality of Mark West Creek, therefore, is again reasonably high, with high dissolved oxygen and low phosphate. Bacterial values for the same station are: June 1971 -- total coliform, 979; fecal coliform, 137; September 1971: TC, 2,544; FC, 473 (all per 100/ml).

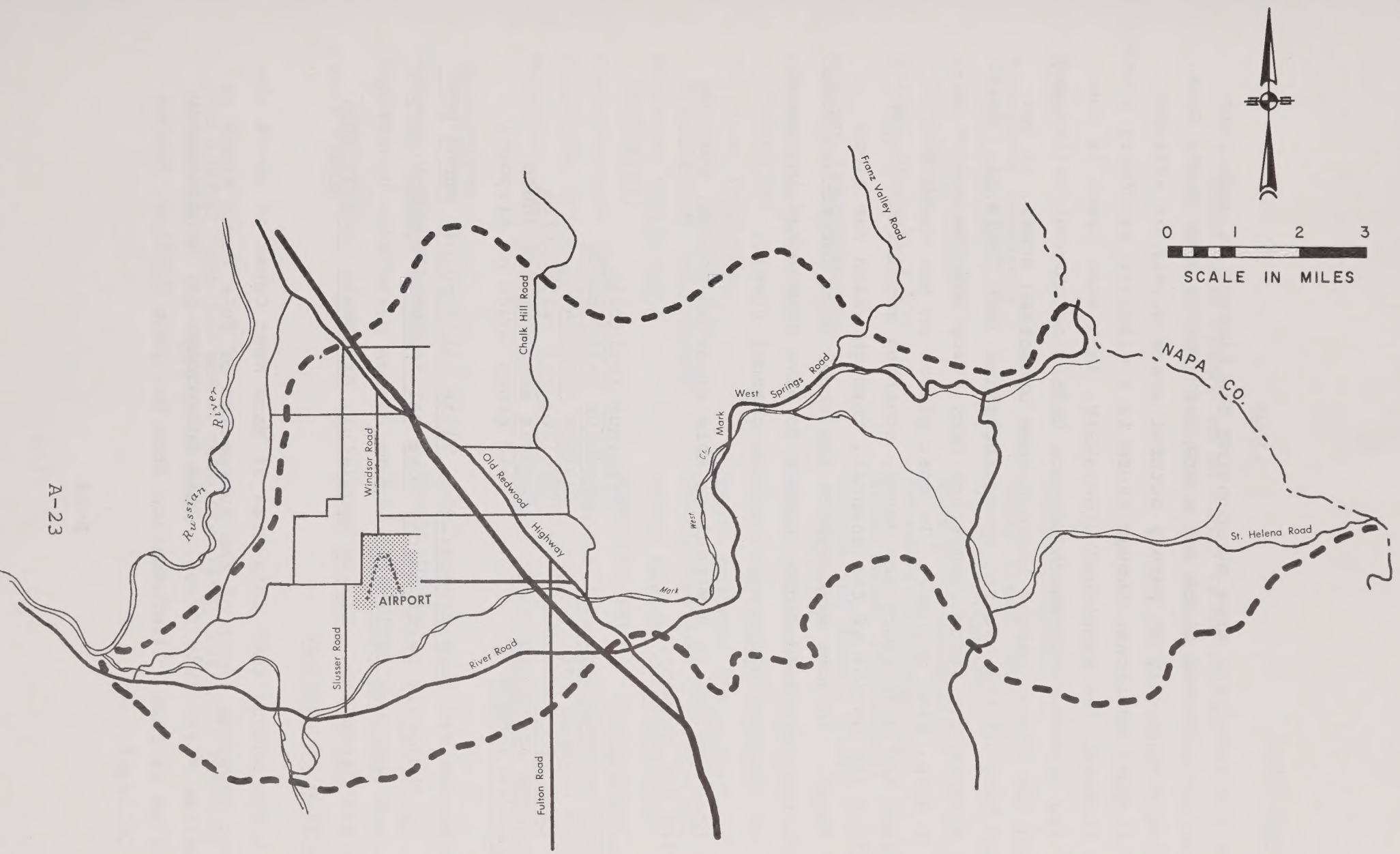


AQUIFER RECHARGE

NATURAL RECHARGE AREAS

1/4 Mi.
1/2 Mi.

FIGURE 4



MARK WEST CREEK WATERSHED

FIGURE 5

Flora and Fauna

Because the immediate area surrounding the Airport is underlain by prime agricultural soils and since the area is near Santa Rosa, there are essentially no purely natural areas within or adjacent to the airport environs, though there is a wildlife sanctuary south of the Airport. As mentioned previously, Mark West Creek is one of the few streams left which has not undergone channelization and although the stream passes through some urbanized areas, it has retained many of its natural characteristics (see Table 2). South of the Airport the stream banks are very steep and the stream occupies a deep, wide channel. In most places on the upper bank, the forest and understory are dense, creating a calm, cool open area along the bottom of the channel, through which the clear stream flows. In some areas where the upper bank forest has been removed, the increased light appears to have stimulated increased growth of willows (Salix spp.) in the channel itself.

No one tree species is dominant in this riparian forest, but the following are common:

Salix spp.	Fraxinus latifolia
Acer macrophyllum	Aesculus californica
Acer negundo var. Californicum	Juglans Hindsii
Quercus agrifolia	Umbellularia californica
Quercus lobata	Sequoia sempervirens (huge old stump south of Airport)

Common shrubs are Rhus diversiloba, Vitis californica, Rubus procerus, Aristolochia californica, Rosa californica, Symphoricarpus albus, and Sambucus callicarpa. Some common herbaceous understory plants are Carex spp., Conium maculatum, Artemesia Donglasiana, and Xathium strumarium.

It is worth noting that this area of Mark West Creek is about the furthest upstream limit of the subspecies of Tule Perch known as the Russian River Tule Perch. This subspecies is "unofficially" classified as rare. (Information from Dr. John Hopkins, Sonoma State College).

Table 2

INHABITANTS LIKELY TO BE FOUND IN OR AROUND MARK WEST CREEK IN VICINITY OF THE AIRPORT*

ALGAE

Bluegreen (Anabaena, Oscillatoria)

Green (Closterium, Cladophora

Golden (Cymbella)

AQUATIC INVERTEBRATES

Amoeba-like protozoa (Polomyxa)

Ciliates (Didinium, Stentor, Vorticella, Stylonychia, Lacrymaria)

Rotifers (Philodina, Euchlanis)

Coelenterates (Hydra)

Flatworms (Planaria)

Annelids (Aeolosoma)

AQUATIC ARTHROPODS

Water fleas (Daphnia)

Copepods (Cyclops)

Amphipods (Grammarus)

Decapods (Procambarus)

Water mites (Hydrachna)

Dragon and damsel flies (Odonata)

Water striders (Gerridae)

Water scorpions (Nepidae)

Water boatman (Corixidae)

Diving beetles (Dytiscidae)

Midge larvae (Tendipedidae)

Mosquito larvae (Culicidae)

Limpets (Ancylidae)

Snails (Physidae)

Clams (Corbiculidae)

VERTEBRATES

Suckers (Catastomidae)

Minnows and chubs (Cyprinidae)

Frogs (Rana)

Toads (Bufo)

Turtles (Clemmys)

* The listed taxa are not a complete list, but will provide one indication of the type of stream.

A list of the mammals and birds likely to be found in the Airport vicinity may be found in Tables 3 and 4, respectively.

The area of the proposed general aviation runway is a grassland with numerous mouse and mole runs and pocket gopher mounds are not uncommon. Black-tailed jack rabbits are common as well as turkey vultures. White-tailed kites are also known to feed in the area, as well as sparrow hawks and meadowlarks. A preliminary report by Gordon Bolander concerning the waste water collection, treatment and disposal facilities for the Airport-Wikiup-Larkfield area lists the bald eagle, golden eagle, and peregrine falcon as residents. These are recongized as rare species.

Most of the central part of the Airport grounds and the area south of the Airport to Laughlin Road is a disturbed annual grassland. The major species include Hordeum hystrix, Lolium spp., Hemizonica pungens and Madia anomala. Minor species include Raphanus sativns, Rumex spp., Pluntago spp., Circium vulgare Tragopogon parvifolius, Potentilla spp., Sitanium jubatum, Chlorogalum pomeridianum and Avena fatua.

Most of the area north of the threshold to Runway 14 has been discussed, except the drainage areas which include some semi-aquatic species such as Typha spp., Salix spp., Conium maculatum, Rhus diversiloba, Rubus procerus, Latus purshianus, and Brassica geniculata, as well as Quercus lobata and Fraxinus latifolia.

Unless otherwise noted, the information on the flora and fauna was provided by Dr. Robert Sherman and Dr. Phil Northen, both of Sonoma State College.

Table 3

MAMMALS LIKELY TO BE FOUND IN THE AIRPORT VICINITY
Sonoma County Airport

Opossum (Didelphis marsupialis)

Trobridge Shrew (Sorex trowbridge

Vagrant Shrew (Sorex vagrans)

Pacific Shrew (Sorex pacificus)

Shrew Mole (Neurotrichus gibbsi)

California Mole (Scapanus latimanus)

Little Brown Myotis (Myotis lucifugus)

Yuma Myotis (Myotis yumanensis)

Long-eared Myotis (Myotis evotis)

California Myotis (Myotis Californicus)

Silver-haired Bat (Lasionyceteris noctivagans)

Western Pipistrel (Pipistrellus hesperus)

Big Brown Bat (Eptesious fuscus)

Red Bat (Lasiurus borealis)

Hoary Bat (Lasiurus cinereus)

Western Big-eared Bat (Plecotus townsendi)

Pallid Bat (Antrozous pallidus)

Mexican Freetail Bat (Tadarida brasiliensis)

Raccoon (Procyon lotor)

Shorttail Weasel (Mustela erminea)

Longtail Weasel (Mustela frenata)

Mink (Mustela vison)

Badger (Taxidea taxus)

Spotted Skunk (Spilogale putorius)

Striped Skunk (Mephitis mephitis)

Feral Pig (Sus scrofa)

Coyote (Canis latrans)

Gray Fox (Urocyon cinereoargenteus)

Bobcat (Lynx rufus)

California Ground Squirrel (Citellus beecheyi)

Townsend Chipmunk (Eutamias townsendi)

Sonoma Chipmunk (Eutamias sonomae)

House Mouse (Mus musculus)

Western Gray Squirrel (Sciurus griseus)

Chickaree (Tamissciurus douglasi)

Northern Flying Squirrel (Glaucomys sabrinus)

Valley Pocket Gopher (Thomomys bottae)

Heermann Kangaroo Rat (Dipodomys heermanni)

Western Harvest Mouse (Reithrodontomys megalotis)

Deer Mouse (Peromyscus maniculatus)

Brush Mouse (Peromyscus boylei)

Dusky-footed Woodrat (Neotoma fuscipes)

California Vole (Microtus californicus)

Norway Rat (Rattus norvegicus)

Muskrat (Ondatra zibethica)

Porcupine (Erethizon dorsatum)

Blacktail Hare (Jackrabbit) (Lepus californicus)

Brush Rabbit (Sylvilagus bachmani)

Mule Deer (Odocoileus hemionus spp. columbianus)

Table 4

BIRDS LIKELY TO BE FOUND IN THE AIRPORT VICINITY
Sonoma County Airport

American Avocet (Recurvirostra americana)
Black-necked Stilt (Himantopus mexicanus)
Wilson's Phalarope (Steganopus tricolor)
Northern Phalarope (Lobipes lobatus)
California Gull (Larus californicus)
Ring-billed Gull (Larus delawarensis)
Caspian Tern (Hydroprogne caspia)
Black Tern (Childonias niger)
Band-tailed Pigeon (Columba fasciata)
Rock Dove (Columba livia)
Mourning Dove (Zenaidura macroura)
California Yellow-billed Cuckoo (Coccyzus americanus)
Barn Owl (Tyto alba)
Screech Owl (Otus asio)
Great Horned Owl (Bubo virginianus)
Pygmy Owl (Glaucidium gnoma)
Long-eared Owl (Asio otus)
Poor-will (Phalaenoptilus nuttallii)
Common Nighthawk (Chordeiles minor)
Vaux's Swift (Chaetura vauxi)
Anna's Hummingbird (Calypte anna)
Rufous Hummingbird (Selasphorus rufus)
Allen's Hummingbird (Selasphorus sasin
Belted Kingfisher (Megaceryle alcyon
Red-shafted Flicker (Colaptes cafer)
Pileated Woodpecker (Dryocopus pileatus)
Acorn Woodpecker (Melanerpes formicivorus)
Lewis' Woodpecker (Asyndesmus lewis)
Yellow-bellied Sapsucker (Sphyrapicus varius)
Red-breasted Sapsucker (Sphyrapicus varius ruber)
Downy Woodpecker (Dendrocopus pubescens)
Hairy Woodpecker (Dendrocopus villosus)
Nuttall Woodpecker (Dendrocopus nuttallii)
Western Kingbird (Tyrannus verticalis)
Ash-throated Fly-catcher (Myiarchus cinerascens)
Black Phoebe (Sayornis nigricans)
Western Fly-catcher (Empidonax difficilis)
Western Wood Peewee (Contopus sordidulus)
Olive-sided Fly-catcher (Nuttallornis borealis)
Horned Lark (Eremophila alpestris)
MacGillivray's Warbler (Oporonis tolmiei)
Yellowthroat (Geothlypis thichas)
Yellow-breasted Chat (Icteria virens)
Wilson's Warbler (Wilsonia pusilla)
House Sparrow (Passer domesticus)
Western Meadowlark (Sturnella neglecta)
Tri-colored Blackbird (Agelaius tricolor)
Redwinged Blackbird (Agelaius phoeniceus)
Bullock's Oriole (Icterus bullockii)
Brewer's Blackbird (Euphagus cyanocephalus)
Brown-headed Cowbird (Molothrus ater)
Western Tanager (Piranga ludoviciana)

Common Loon (Gavia immer)
Western Grebe (Aechmophorus occidentalis)
Great Blue Heron (Ardea herodias)
Green Heron (Butorides virescens)
Common Egret (Casmerodius albus)
Snowy Egret (Leucophoyx thula
Least Bittern (Ixobrychus exilis)
American Bittern (Botaurus lentiginosus)
Mallard (Anas platyrhynchos)
Pintail (Anas acuta)
Green-winged Teal (Anas carolinensis)
Cinnamon Teal (Anas cyanoptera)
American Widgeon (Mareca americana)
Gadwall (Anas strepera)
Shoveler (Spatula clypeata)
Wood Duck (Aix sponsa)
Ring-necked Duck (Aythya collaris)
Canvasback (Aythya valisineria)
Greater Scaup (Aythya marila)
Lesser Scaup (Aythya affinis)
Common Goldeneye (Bucephala clangula)
Bufflehead (Bucephala albeola)
Common Merganser (Mergus merganser)
Turkey Vulture (Cathartes aura)
White-tailed Kite (Elanus leucurus)
Goshawk (Accipiter gentilis)
Sharp-shinned Hawk (Accipter striatus)
Coopers Hawk (Accipter cooperii)
Red-tailed Hawk (Buteo jamaicensis)
Red-shouldered Hawk (Buteo lineatus)
Rough-legged Hawk (Buteo lagopus)
Golden Eagle (Aquila chrysaetos)
Marsh Hawk (Circus cyaneus)
Osprey (Pandion haliaetus)
Peregrine Falcon (Falco peregrinus)
Pigeon Hawk (Falco columbarius)
Sparrow Hawk (Falco sparverius)
California Quail (Lophortyx californicus)
Mountain Quail (Oreortyx pictus)
Ring-necked Pheasant (Phasianus colchicus)
Virginia Rail (Rallus limicola)
Sora (porzana carolina)
Yellow Rail (Coturnicops noveboracensis)
American Coot (Fulica americana)
Killdeer (Charadrius vociferus)
Common Snipe (Capella gallinago)
Long-billed Curlew (Numenius americanus)
Spotted Sandpiper (Actitis macularia
Greater Yellowlegs (Totanus melanoleucus)
Least Sandpiper (Erolia minutilla
Dunlin (Erolia alpina)
Long-billed Dowitcher (Limnodromus scolopaceus)
Western Sandpiper (Ereunetes mauri)
Black-headed Grosbeak (Pheucticus melanocephalus)
Lazuli Bunting (Passerian amoena)
Western Evening Grosbeak (Hesperiphona vespertina)
Purple Finch (Carpodacus purpureus)
House Finch (Carpodacus mexicanus)
Pine Siskin (Spinus pinus)
American Goldfinch (Spinus tristis)
Lesser Goldfinch (Spinus psaltria)
Red Crossbill (Loxia curvirostra)

Violet-green Swallow (Tachycineta thalassina
Rough-winged Swallow (Stelgidopteryx ruficollis)
Barn Swallow (Hirundo rustica)
Cliff Swallow (Petrochelidon pyrrhonota)
Purple Martin (Progne subis)
Steller's Jay (Cyanocitta stelleri)
Scrub Jan (Aphelocoma coerulescens)
Common Raven (Corvus corax)
Common Crow (Corvus brachyrhynchos)
Chestnut-backed Chickadee (Parus rufescens)
Plain Titmouse (Parus inornatus)
Common Bushtit (Psaltriparus minimus)
White-breasted Nuthatch (Sitta carolinensis)
Red-breasted Nuthatch (Sitta canadensis)
Brown Creeper (Certhis familiaris)
Wrentit (Chamaea fasciata)
Dipper (Cinclus mexicanus)
House Wren (Troglodytes aedon)
Winter Wren (Troglodytes troglodytes)
Bewick's Wren (Thryomanes bewickii)
Long-billed Marsh Wren (Telmatodytes palustris)
Mockingbird (Mimus polyglottos)
California Thrasher (Toxostoma redivivum)
Robin (Turdus migratotius)
Varied Thrush (Ixoreus naevius)
Hermit Thrush (Hylocichla guttata)
Swainson's Thrush (Hylocichla ustulata)
Western Bluebird (Sialia mexicana)
Blue-gray Gnatcatcher (Polioptila caerulea)
Golden-crowned Kinglet (Regulus satrapa)
Ruby-crowned Kinglet (Regulus calendula)
Water Pipit (Anthus spinoletta)
Cedar Waxwing (Bombycilla cedrorum)
Loggerhead Shrike (Lanius ludovicianus)
Starling (Sturnus vulgarus)
Hutton's Vireo (Vireo huttoni)
Warbling Vireo (Vireo gilvus)
Orange-crowned Warbler (Vermivora celata)
Yellow Warbler (Dendroica petechia)
Audubon's Warbler (Dendroica auduboni)
Myrtle Warbler (Dendroica coronata)
Black-throated Gray Warbler (Dendroica nigrescens)
Townsend's Warbler (Dendroica townsendi)
Hermit Warbler (Dendroica occidentalis)
Rufous-sided Towhee (Pipilo erythrophthalmus)
Brown Towhee (Pipilo fuscus)
Spotted Towhee (Pipilo maculatus)
Savannah Sparrow (Passerculus sandwichensis)
Lark Sparrow (Chondestes grammacus)
Oregon Junco (Junco oreganus)
Chipping Sparrow (Spizella passerina)
White-crowned Sparrow (Zonotrichia leucophrys)
Golden-crowned Sparrow (Zonotrichia atricapilla)
Fox Sparrow (Passerella iliaca)
Lincoln's Sparrow (Melospiza lincolnii)
Song Sparrow (Melospiza melodia)
White-throated Sparrow (Zonotrichia albicollis)

PROBABLE IMPACTS ON THE HUMAN AND NATURAL ENVIRONMENT

This section compares the project description with the environmental setting in order to predict the probable impact of the project. Although this report is being developed at the planning stage only, an attempt will be made to evaluate both the long- and short-term effects, as well as the direct and indirect ones.

Aircraft Noise

The impact of aircraft noise upon residential populations is potentially one of the most critical of all environmental factors associated with airport development and aircraft operations.

The subjective reactions of people to noise have been primarily studies from two viewpoints: (1) the precise quantitative relation between the physical characteristics of sound and the subjective attributes of pitch, loudness, and noisiness, and (2) the physiological or psychological reactions that tend to affect general behavior and to interfere with performance of physical or mental work. It is the noisiness rather than the loudness that is of most importance in the context of estimating adverse reaction to sound; it is also an experimentally established fact that the loudness of a sound as established by physical measurements does not necessarily correspond with its loudness and noisiness as judged subjectively. Reasonably high correlations have been found between (1) judgments of the noisiness of sounds in general and the sounds from piston-driven and jet aircraft and (2) the so-called "perceived noise level" as indicated by PNdB. The latter is a scale utilized to evaluate objectively, on a quantitative scale, a measure of the noise which closely matches a listener's annoyance.

In interpreting perceived noise levels, it should be noted that a change of 10 PNdB corresponds to a subjective judgment of the halving or doubling of the noisiness of the sound. That is, a sound judged to be twice as noisy as another sound would have a perceived noise level rating approximately 10 dB greater than the first sound; 20 PNdB greater than the first sound would be rated as four times as noisy as the first sound. A difference of 1 or 2 PNdB between sounds, although detectable if heard within a short time interval, would not be judged very significant by most observers (17). High-pitched noises are given greater weighting than low pitched noises since different frequency bands are weighted in a manner corresponding to the relative sensitivity of the ear to the different frequency components.

The noise measure used for sound having a more continuous nature is the A-level. This is obtained by using a frequency weighting network which has the inverse of a presumed loudness characteristic of the ear. The A-level has been used for many years as a measure of urban noise, surface vehicle noise, industrial noise, and aircraft noise (10). The following tabulation shows the suggested noise limits for nonoccupational noise exposure.

Maximum Suggested Nonoccupational Exposure

Sound Level (dBA)	Daily Exposure Time
70	16-24 Hours
75	8 "
80	4 "
85	2 "
90	1 "
95	30 Minutes
100	15 "
105	8 "
110	4 "
115	2 "

Source: Environmental Protection Agency, Fundamentals of Noise: Measurement, Rating Schemes, and Standards. 1971.

As an aircraft flies past an observer, the noise level increases over a period of several seconds, reaches a maximum level, and then decreases gradually. The maximum flyover noise will vary widely, largely as a function of the type of aircraft, type of operations, and the distance between the aircraft and the observer (32). In precise terms, the principal determinants of sound in this situation are: (1) the power of the source, (2) the directivity of the source, (3) geometric spreading, (4) air absorption, and (5) ground reflection. Determinants 1 and 2 are source characteristics and 3 and 4 are the principal propagation effects; 5 is important, but easy to evaluate -- the ground reflection simply adds 3 dB to the received sound level at a normal height of the observer's ear above the ground. The major sources of noise generation from aircraft are detailed below.

	Major Noise Sources	
Type of Aircraft	Broadband Noise	Discrete Frequency Noise
Jet Propulsion	Jet Exhaust - turbulent mixing of exhaust gases with air	Turbomachinery - turbulence produced by rotating blades: Fan Noise, Compressor Noise, Turbine Noise
Propeller Driven	Vortex formation and shedding in flow past blade	Rotational noise - oscillating pressure field on the air with blade passage; Blade Slap - fluctuating forces on blade

Source: CLM Systems, Inc. Airports and Their Environment, A Guide to Environmental Planning. 1972

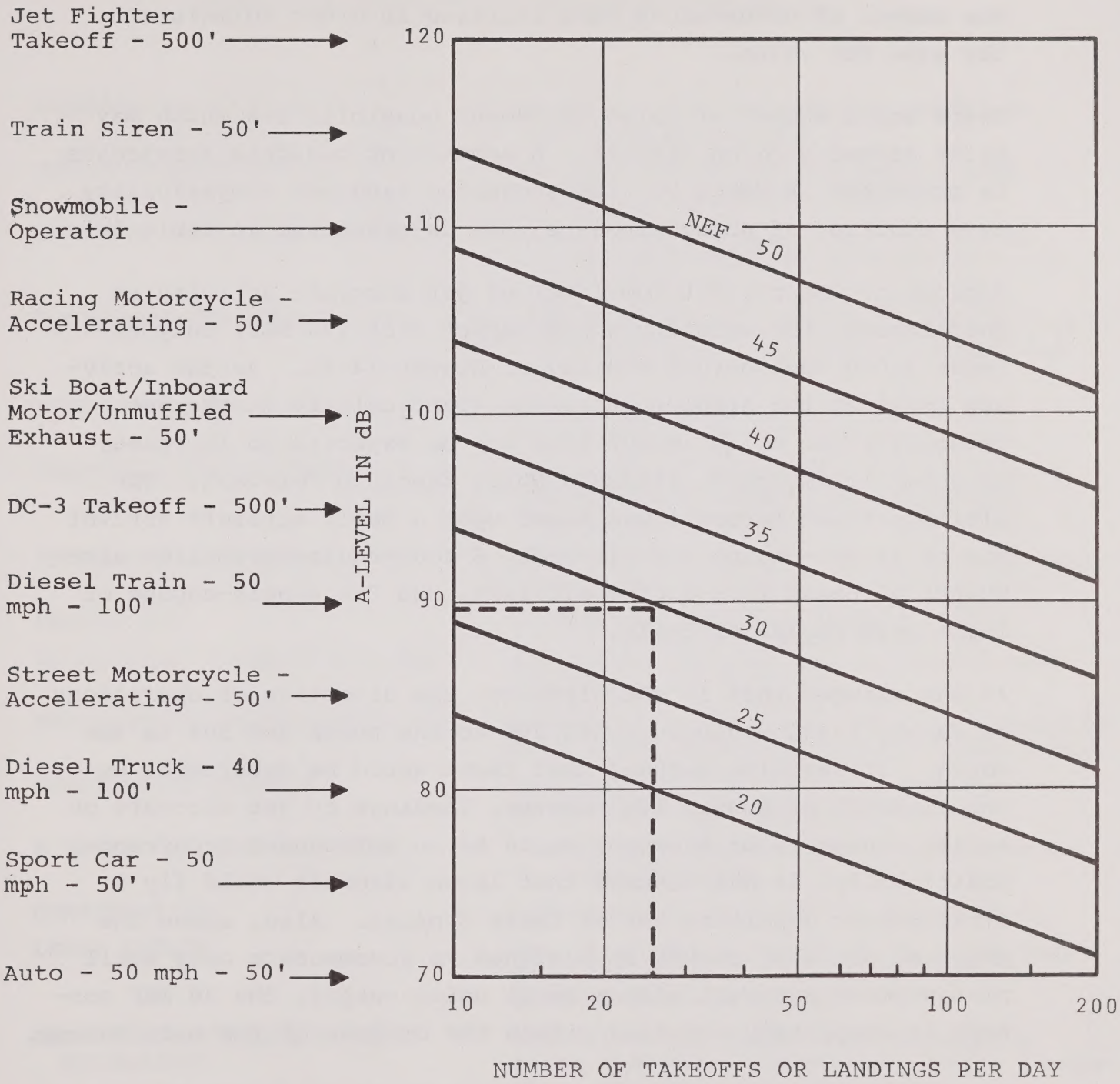
Geometric spreading for "point" sources is simply 6 dB of loss per doubling of distance. Refraction of the sound may change this slightly. There is more uncertainty in the air absorption.

Ground runup noise generally differs in character from flyover noise in that the noise maximum will be lower, but with longer duration. As with flyover noise, the levels will vary according to the type of aircraft, engine power setting, and distance to the observer. The noise due to aircraft flyovers even in communities immediately adjacent to an airport cannot cause any significant auditory fatigue because the noise occurs for very brief periods followed by long periods of relative quiet. Continued exposure to jet engine noise at close distances may constitute a hearing hazard unless suitable ear protection devices are worn. Maintenance and loading areas may be exposed to noise from run-ups, aircraft taxiing, and other operational and maintenance activities.

Over the past ten years, the Federal Aviation Administration and acoustical researchers have developed several methods of forecasting the effects of airport noise upon the surrounding communities. One of the primary aircraft noise forecasting techniques in the United States is the Noise Exposure Forecast (NEF) method. NEF employs Effective Perceived Noise decibels (EPNdB) as the aircraft noise measurement unit and thereby accounts for discrete tones and duration of aircraft flyover.

The other factors which are related in a complex mathematical relationship are absolute noise levels, noise spectrum, maximum tone, noise duration, aircraft type, mix of aircraft, number of operations, runway utilization, flight path, operating procedures, and time of day.

Figure 6 shows an approximate relationship between NEF and common sound experiences that most people will be able to relate to. For example, if a person is in the 30 NEF contour, and experiences 25 daily flyovers of a "typical jet aircraft", each occurrence has an equivalent single noise event as a diesel train passing 100 feet from the individual at 50 mph. Since NEF is a function of



NEF RELATIONSHIPS

FIGURE ●

both sound level and number of occurrences, it can be seen from the figure that as the intensity of the south decreases the number of occurrences must increase in order to maintain the same NEF value.

There are a number of noise abatement possibilities which may exist around a given airport. A summary of possible strategies is presented in Table 5. The suggested land use compatibility as a function of noise exposure zone is presented in Table 6.

Because of the present low level of jet aircraft activity at the Airport, the existing noise impact area (30 NEF) only extends 3,000 feet beyond the end of Runway 14-32. As the activity level at the Airport increases (particularly in the jet category), the noise impact area may be expected to increase, as shown in Figure 7, Ultimate Noise Exposure Forecast. The ultimate noise forecast was based upon a daily aircraft arrival mix of 14 two-engine jet aircraft, 6 four-engine propeller aircraft, 40 heavy twin-engine aircraft, and 240 single-engine or light twin-engine aircraft.

It was assumed that in the ultimate, the direction of operations on Runway 14-32 would be split 50% to the north and 50% to the south. It was also assumed that there would be departures by jet aircraft on Runway 19; however, landings by jet aircraft on either Runway 19 or Runway 1 would be an infrequent occurrence. Additionally, it was assumed that large aircraft would fly a straight-out departure for at least 3 miles. Also, since the proposed parallel runway is designed to accommodate only small piston-power aircraft with a small noise output, the 30 NEF contour is completely engulfed within the contour of the main runway.

Because the noise exposure forecast is based upon some degree of subjectivity, it must be recognized that these contours merely delineate areas where there is a high probability of an adverse noise impact. The NEF method of forecasting noise impacts is

Table 5

SUMMARY LIST OF NOISE ABATEMENT STRATEGIES

OPERATIONAL CHANGES	Changes in routes, flight profiles, operating techniques.
SCHEDULE RESTRICTIONS	Restricting flight schedules, such as forbidding night flights.
AIRCRAFT TYPE RESTRICTIONS	Restricting aircraft type in use at the airport, such as forbidding four-engine jets, etc.
TECHNOLOGICAL CHANGE	Engine redesign, airframe changes, new aircraft types, electronic navigation aids, etc.
AIRPORT SYSTEM CHANGE	Change in airport location or use, construction of new airports, etc.
TRAFFIC DEMAND CHANGE	Increase or decrease in air transport demand due to other transportation, communications, social change, etc.
ENCOURAGING COMPATIBLE USE	Policies that encourage noise-compatible facilities to locate in noise areas.
PUBLIC USE	Public use of noise impact areas.
RELOCATING INCOMPATIBLE USE	Relocating existing incompatible uses outside noise areas.
PROHIBITING INCOMPATIBLE USE	Prohibiting additional uses incompatible with noise from locating in noise areas.
SENSITIVITY CHANGES	Changing sensitivity of noise receiver, as through insulation or masking.
AIRPORT ENVIRONS PLANNING	Planning of development with attention to noise problems.
COMPENSATION	Compensation to those in noise areas.
LEGAL ACTION	Use of existing legal channels to force adoption of noise abatement measures, gain compensation, etc.
REGULATION, ADMINISTRATIVE MECHANISMS	Regulation of operations specifying noise abatement techniques, noise limits, etc.; coordination mechanisms.
ECONOMIC INCENTIVES	Use of variable fines or fees to encourage noise abatement measures.
INFORMATION	Market service strategies providing information to individuals, businesses, and government agencies.

Source: CLM/Systems, Inc. Airports and Their Environment, A Guide To Environmental Planning. NTIS PB-219957. 1972

Table 6

NOISE EXPOSURE FORECAST (NEF) AND SUGGESTED LAND USE COMPATIBILITY

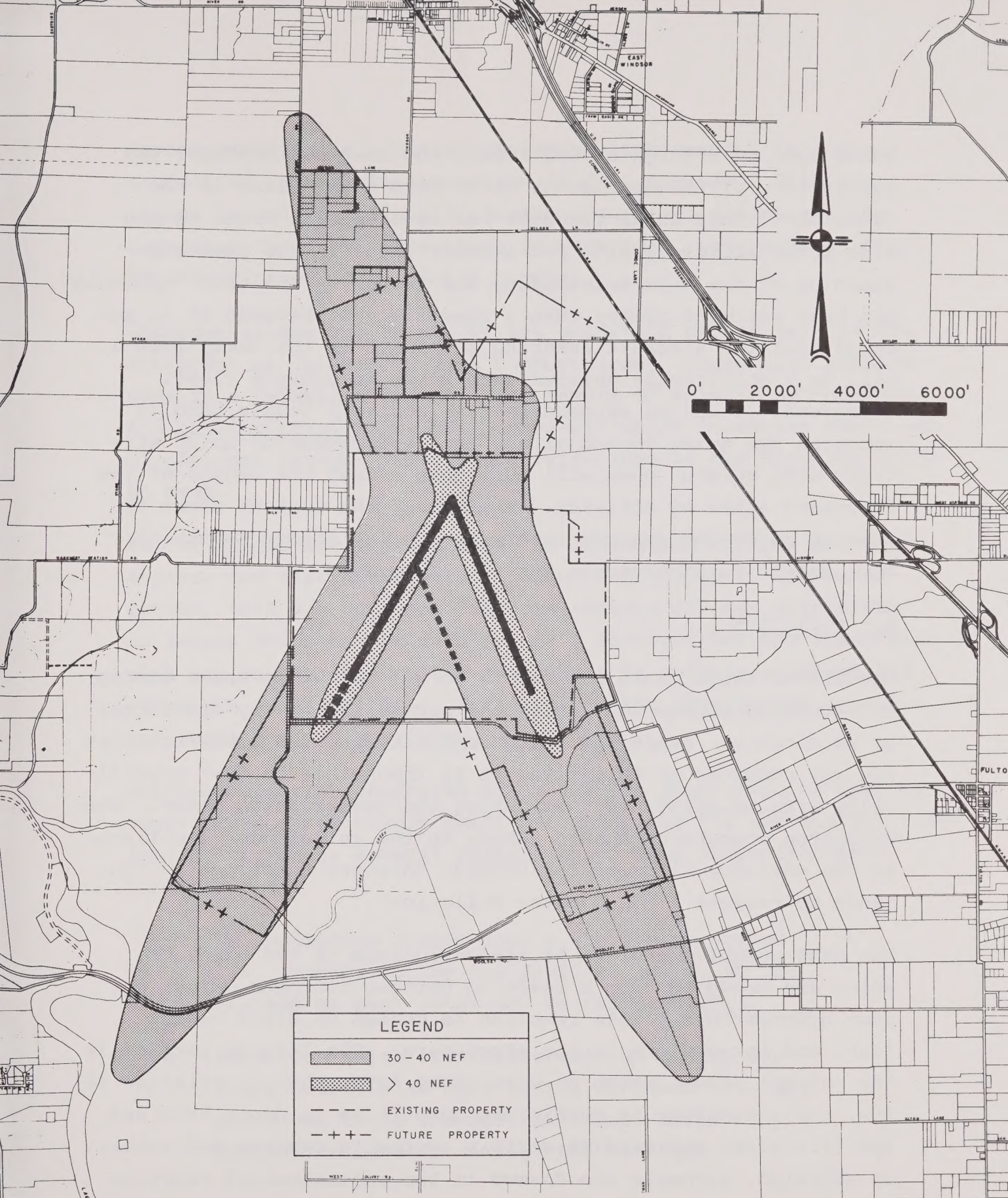
Sonoma County Airport

Land Use	Noise Exposure Forecast <30 NEF	30-40 NEF	>40 NEF
Residential	Yes	Yes[1/]	No
Commercial	Yes	Yes	Yes[2/]
Hotel, Motel	Yes	Yes[2/]	No[2/]
Office and Public Buildings	Yes	Yes[2/]	No[2/]
Schools, Hospitals, Churches	Yes[2/]	No	No
Theaters and Auditoriums	Yes[2/]	No	No
Outdoor Recreation	Yes	Yes	Yes
Industrial	Yes	Yes	Yes[2/]
Agricultural	Yes	Yes	Yes

Notes: 1/ Single dwelling structure should be avoided. Multi-family dwellings may require sound-proofing.

2/ Acoustical studies should be conducted to determine if noise proofing is required.

Source: Bolt, Beranek, and Newman, Inc., Procedures for Developing Noise Exposure Forecast Areas for Aircraft Flight Operations, August 1967.



ULTIMATE NOISE EXPOSURE FORECAST

FIGURE 7

based upon an average annual impact and does not consider the variability of the weather or short-term alterations in the fleet mix. This noise forecast was developed in order to provide local officials with yet another input in the land use planning of the area surrounding the Airport. The term "ultimate" has been employed rather than a specific year because it is assumed that the aircraft entering the fleet in the early 1980's will be significantly quieter than those in today's fleet. Therefore, it can be assumed that as activity levels tend to increase the noise impact areas, the replacement of noisy aircraft with quieter ones will more than offset the impact of the increased level of activity. Therefore, the contour shown is assumed to be the maximum level expected at Sonoma County Airport using the most recent activity forecasts.

Air Pollution

Conditions which could contribute to air pollution arise during construction phases and during the normal day-to-day operations of an airport. Since the design and construction specifications are not complete at this time, it is impossible to deal specifically with pollution sources during the construction phase. Construction operations should adhere to the guidelines established in FAA Advisory Circular 150/5370-7, "Airport Construction Controls to Prevent Air and Water Pollution".

The most ubiquitous class of air pollutants is the oxidants, which are produced from a reaction between nitrogen oxides and some hydrocarbons. This reaction is caused by ultra-violet light and takes place in the atmosphere. The largest portion is the oxidant ozone, which on warm sunny days, when ventilation is low, can accumulate in sufficient quantities to cause skin and eye irritation and oxidize certain synthetic fabrics and rubber. In addition, aerosols are formed in the photochemical reaction and these contribute to visibility reduction.

Carbon monoxide is a toxic substance which results as a by-product of incomplete combustion in fuel engines. This substance is emitted primarily during ground operations and the amount produced by jet engines is much less, per pound of fuel, than that produced by piston engines.

Nitrogen oxides are formed by the oxidation of air (air is 80% nitrogen) at relatively high temperatures. Since high temperature is a technique for reducing levels of emitted hydrocarbons and particulates, there is a trade-off which increases the level of nitrogen oxides. Nitrogen dioxide imparts the brownish color to smog.

Sulfur oxides are a product of the combustion of fuel in jet engines and also automobiles. Under conditions of low ventilation, this gas does not disperse rapidly and may accumulate to levels which may be deleterious. Particulates are associated with jet engine exhaust and contribute to soiling problems and reduction in visibility. In addition, the particulate fraction may contain toxic particles.

Although aviation generated air pollution from airports usually contributes a relatively small percentage of the ambient air pollution, there are several factors which make it particularly troublesome:

- The pollution occurs over a short time period, i.e., mostly during the daylight hours, so the maximum or peak rates may be fairly high.
- Emissions which are most prominent during daylight hours, when most people are outdoors, are perceived to be the most hazardous and more aesthetically displeasing than at night.

- Most airports are at the periphery of towns or cities where people expect cleaner air than in the city.

- Reaction to air pollution is influenced by other undesirable characteristics such as noise and ground traffic.

- There are almost no benefits to the people who live in the immediate vicinity, so tolerances are therefore usually low.

Carbon monoxide usually contributes the largest amount of air pollution to the total emissions of an air carrier airport, followed by total hydrocarbons, nitrogen oxides, either sulfur dioxide or particulates, and lead. Specific emissions are more likely to occur at different times during the operation of an aircraft:

- The taxi mode is the biggest contributor of carbon monoxide, lead, and total hydrocarbons.

- The major portion of the nitrogen oxide, sulfur dioxide, particulate, and aldehyde (an organic) occurs during the approach and climb-out modes.

- Other important modes are the idle on runway mode (carbon monoxide, lead, and total hydrocarbons) and the fuel venting mode (total hydrocarbons).

The following tabulation, developed by the Bay Area Pollution Control District in 1971, demonstrates the relative amount of air pollution within the Bay Area by major source.

DISTRIBUTION OF BAY AREA AIR POLLUTION BY SOURCE

Source	Part.	Organic	NOx	SOx	CO	TOTAL
Motor Vehicles	23.2%	55.6%	68.1%	5.4%	95.0%	80.6%
Aircraft	9.9%	1.7%	1.4%	1.7%	1.0%	1.4%
Other	66.9%	42.7%	30.5%	92.9%	4.0%	18.0%

From the above tabulation it can be seen that aircraft contribute a very minor portion to the overall air pollution of the Bay Area. This, of course, does not eliminate the need to consider aircraft generated air pollution in the environmental impact assessment process.

Under the Clean Air Act of 1970, the Environmental Protection Agency has the authority to establish emission standards for aircraft or aircraft engines that in the Agency's judgment cause or contribute to or are likely to cause or contribute to air pollution which endangers the public health or welfare. The EPA has proposed standards for the control of air pollution from aircraft engines which, if approved, will reduce air pollution around all airports. National ambient air quality standards as amendments to the 1970 Clean Air Act as well as the California State air quality standards are presented in Table 7.

The information in Table 8 illustrates air pollution data that was prepared during the San Francisco Bay Area Regional Airports Study. This table readily shows the role of aircraft within the total air pollution picture.

There are no air quality measurements made directly at the Sonoma County Airport. Air pollutants demonstrate considerable spatial variability because of proximity to source and climatic features. The ambient air quality in Santa Rosa, as measured on Humbolt Street, is shown in Table 9. It should be stressed that these

Table 7

NATIONAL AND CALIFORNIA STATE
AIR QUALITY STANDARDS

National Ambient Air Quality Standards

	Primary Standard		Secondary Standard	
	ug/m^3	ppm	ug/m^3	ppm
Sulfur Oxides				
Annual Arithmetic Mean	80	0.030	60	0.021
24-Hour Concentration	365*	0.137*	260*	0.091
Suspended Particulate Matter				
Annual Geometric Mean	75		60	
24-Hour Concentration	260*		150*	
Carbon Monoxide				
8-Hour Concentration		9.000		9.000
1-Hour Concentration		35.000		35.000
Photochemical Oxidants				
1-Hour Concentration	160*	0.080*	160*	0.080*
Hydrocarbons (Corrected for Methane)				
3-Hour Concentration (6 a.m. - 9 a.m.)	160*	0.240*	160*	0.240*
Nitrogen Oxides				
Annual Arithmetic Mean	100	0.053	100	0.053

* Not to be exceeded more than once a year.

California State Air Quality Standards - 1970

	State Standard
Oxidant	0.10 ppm for 1 hour
Carbon Monoxide	10.0 ppm for 12 hours
Sulfur Dioxide	0.04 ppm for 24 hours 0.50 ppm for 1 hour
Particulates	60 ug/m^3 annual geometric mean. No single 24-hour sample to exceed 100 ug/m^3
Nitrogen Dioxide	0.25 ppm for 1 hour

Table 8

COMPARISON OF ESTIMATED AIR POLLUTANT EMISSION LEVELS
NINE-COUNTY SAN FRANCISCO BAY AREA

	EMISSIONS - TONS PER DAY					
	Particulates	Carbon Monoxide	Nitrogen Oxides	Organic	Sulfur Oxides	TOTAL[1/]
1970 Demand						
Total 9-County	247	6317	672	1885	342	9463
All Aircraft	16.3	64.0	8.5	29.1	3.5	121
General Aviation Only[2/]	0.2	13.0	0.8	2.7	--	17
Sonoma County Airport Only	*0.01*	*0.50*	*0.03*	*0.10*	--	*0.6*
Other Airport Activities[3/]	0.5	12.7	1.0	3.1	0.1	17
1975 Demand						
Total 9-County	231	4083	669	1430	304	6717
All Aircraft	15.3	77.6	21.4	28.3	4.1	147
General Aviation Only[2/]	1.0	24.1	1.8	5.1	0.1	32
Sonoma County Airport Only	*0.04*	*0.88*	*0.07*	*0.18*	*0.01*	*1.2*
Other Airport Activities[3/]	0.5	12.1	1.9	2.7	0.1	17
1980 Demand						
Total 9-County	260	2104	545	1173	334	4416
All Aircraft	20.7	104.0	32.8	33.9	5.6	197
General Aviation Only[2/]	2.1	35.5	2.9	7.7	0.3	49
Sonoma County Airport Only	*0.07*	*1.27*	*0.10*	*0.27*	*0.01*	*1.7*
Other Airport Activities[3/]	0.6	7.9	1.9	1.9	0.2	12
1985 Demand						
Total 9-County	292	1294	458	1168	372	3584
All Aircraft	27.1	141.0	53.2	40.4	8.3	270
General Aviation Only[2/]	3.5	50.4	4.4	11.0	0.5	70
Sonoma County Airport Only	*0.12*	*1.72*	*0.15*	*0.38*	*0.02*	*2.4*
Other Airport Activities[3/]	0.8	5.4	1.5	1.8	0.4	10

Notes: 1/ Totals are rounded.
2/ Excludes general aviation at San Francisco International, Oakland (north & south) San Jose Municipal, and all military airfields.
3/ Total non-aircraft airport-related activity emissions at all Bay Area airports.

Source: Association of Bay Area Governments, Regional Airport Systems Study, Aviation Effect On Air Quality, 1971.

Table 9

AMBIENT AIR QUALITY DATA - SANTA ROSA, CALIFORNIA*
(Figures in Parts Per Million, Except as Otherwise Noted)

	TYPE OF POLLUTANT									
	Oxidants		Carbon Monoxide		Nitrogen Oxides		Hydrogen Carbon		Particulates	
	Max. Hourly Avg.	Avg. Max. Hourly	Max. Hourly Avg.	Avg. Max. Hourly	Max. Hourly Avg.	Avg. Max. Hourly	Max. Hourly Avg.	Avg. Max. Hourly	Highest Daily Average	Max. Daily ug/m^3
1970										
September	0.10	0.04	8	4	0.18	0.07	6	4	1.0	
October	0.07	0.03	11	4	0.23	0.07	9	4	1.0	
November	0.05	0.02	8	4	0.25	0.08	6	4	0.6	
December	0.04	0.02	8	4	0.20	0.07	7	4	0.8	
1971										
January	0.03	0.01	10	4	0.23	0.09	8	4	1.8	
February	0.05	0.03	7	3	0.25	0.07	7	4	0.7	
March	0.06	0.03	6	3	0.16	0.06	5	3	0.4	35
April	0.06	0.03	3	2	0.13	0.05	6	3	0.3	48
May										70
1972										
August	0.09	0.04	7	3	0.19	0.05	4	2	0.5	73
September	0.09	0.06	10	4	0.26	0.07	6	2	0.4	83
October	0.12	0.05	10	5	0.20	0.07	7	3	0.6	83
November	0.23	0.03	20	6	0.80	0.18	8	4	0.9	74
December	0.05	0.01	11	6	0.30	0.15	8	5	0.9	85
1973										
January	0.07	0.03	9	5	0.25	0.12	8	4	0.9	75
February	0.08	0.04	12	6	0.50	0.12	8	3	0.4	70
March	0.09	0.04	7	5	0.25	0.07	6	3	0.3	43
April	0.12	0.05	9	4	0.13	0.05	5	3	0.4	52
May	0.04	0.02	7	4	0.10	0.04	5	2	0.3	72
June	0.11	0.03	9	5	0.18	0.05	6	2	0.3	79

* Samples collected at Humbolt Street Station.

figures are only a general indication of regional air quality and do not represent the ambient conditions at the Airport. Within this table, Maximum Hourly Average is the worst reading of the month, while Average Maximum Hourly is the average of the maximum level recorded each day of the month.

If the aircraft operations are known or forecast, and if the air pollutant emission factors are known for each aircraft, then it is possible to predict the total air pollution which will be produced directly from aircraft activities. To facilitate the analysis of pollutant emission resulting from aircraft activities, an aircraft operational cycle has been defined (LTO) and this cycle includes all normal operational modes performed by an aircraft between the time it descends through an altitude of 3,500 feet until it again passes through the 3,500-foot altitude after takeoff. The term operation is used to describe either a landing or a takeoff; therefore, there are two operations per LTO cycle.

In Table 10 actual (1972) and projected (1985 and 1995) air pollutants are presented by aircraft type. As can be seen, the pollutant levels are forecast to increase from between about 6-fold in the case of hydrocarbons and carbon monoxide to about 40-fold in sulfur oxides.

Projected air pollutants from vehicular traffic can also be calculated from vehicle emission factors and average annual daily traffic. The data shown in the following tabulation assume an 18 mile round trip from Santa Rosa to the Airport and utilize rural or constant speed driving conditions. The air pollution from vehicular activity is relatively low, and is of the same order of magnitude as that emitted by aircraft (Table 12).

PROJECTED AIR POLLUTANTS GENERATED FROM
VEHICULAR TRAFFIC TRAVELING FROM
SANTA ROSA TO SONOMA COUNTY AIRPORT AND RETURN

Pollutant Type	Tons per Year 1972	1985	1995
Carbon monoxide	234.8	556.5	632.4
Hydrocarbons	30.5	63.6	72.3
Nitrogen oxides	29.0	78.1	88.7
Particulates	1.4	1.6	1.8

*Years 1985 and 1995 are calculated using 1975 emission factors.

The data presented in Table 10 are simply the projected amounts of air pollutants which will be produced during a given year. However, to assess the impacts of these pollutants, it is necessary to predict the concentrations which will occur at or near the Airport. This can be done using a mathematical model which makes certain assumptions and then distributes the air pollutants in terms of time and space. Some models are very simple and make large assumptions; others make fewer and/or smaller assumptions and are more complex. However, all air pollution models are simply predictive devices and the results obtained from them should be regarded as only estimates.

A model which predicts air pollutants around an airport should recognize that pollutants are generated on the ground, but also by arriving and departing aircraft. After an aircraft reaches an altitude of 3,000 AGL, however, it is assumed that the generated pollutants disperse in the atmosphere and do not reach the ground.

One of the models used in this report was a hybrid model using point source and integrated line source techniques. The line source portion permits the prediction of pollutants emitted along a runway and is expressed in terms of the airport boundaries to account for vehicular and ground operations. The point source

Table 10

PROJECTED TOTAL AIR POLLUTANT EMISSIONS
GENERATED BY EACH AIRCRAFT TYPE
SONOMA COUNTY AIRPORT
Santa Rosa, California

(Figures in Tons per Year)

Aircraft Type	Type of Pollutant				
	Particulates	Sulfur Oxides	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Single Engine Piston					
1972	4.7	0.2	129.3	9.4	2.1
1985	14.3	0.7	392.1	28.5	6.4
1995	12.4	0.6	339.6	24.7	5.6
Light Twin Piston					
1972	1.6	0.1	44.1	3.2	0.7
1985	6.1	0.3	167.2	12.2	2.7
1995	7.6	0.4	209.0	15.2	3.4
Heavy Twin Piston					
1972	0.1	0.3	314.1	91.7	0.4
1985	0.6	1.5	1561.8	456.0	2.1
1995	1.0	2.5	2603.0	760.0	3.4
Turbo-Prop					
1972	3.0	1.0	1.0	2.0	3.0
1985	34.2	5.7	5.2	17.1	28.5
1995	57.0	9.5	8.6	28.5	47.5
Turbo-Fan					
1972	4.0	1.0	4.0	1.0	4.0
1985	39.9	11.4	41.6	7.8	39.9
1995	66.5	19.0	69.4	12.9	66.5
Total - All Aircraft Types					
1972	13.4	2.6	492.5	107.3	10.2
1985	95.1	19.6	2167.9	521.6	79.6
1995	144.5	32.0	3229.6	841.3	126.4

portion permits the calculation of pollutants generated by arriving and departing aircraft.

The assumptions were that the pollution source boundaries were 305 meters by 1,830 meters and this rectangle was oriented around Runway 14-32. The average wind speed was approximately 3 meters per second (6.6 mph) and from the south through a 22.5' angle. These are rather severe assumptions, since all pollutants are assumed to pass over the downwind boundary of the Airport with relatively little vertical diffusion, under relatively low dispersion conditions.

The calculated values for air pollutants under stable and unstable atmospheric conditions are shown in Table 11. According to these values, particulates will exceed the State standards by 1985 at 1 kilometer downwind. By 1995, the State standards would be exceeded at 2 kilometers only under stable atmospheric conditions. Sulfur dioxide will exceed the standards at the downwind boundary by 1995. Carbon monoxide will exceed the standards only at the boundary under stable conditions by 1995. The national standard for hydrocarbons (calculated as methane) will be exceeded under stable conditions by 1985 at a distance of 1 kilometer. Nitrogen dioxide will exceed the State standards at the downwind boundary by 1995.

Based on a relatively small number of studies, the concentrations of both NO_2 and SO_2 are below the levels where damage might occur to fruit trees (Hindawi, 1970; Millecan, 1971).

The predicted air pollutant levels are significantly higher than those predicted from models which allow all the air pollutants to be dispersed through a volume of air dimensioned around the airport. A modeling technique which does allow dispersion is found in Department of Transportation, Federal Aviation Administration, Airport Division AWE-600, "Guide for Preparing Environmental

Table 11

AIR POLLUTANT LEVELS
UNDER STABLE AND UNSTABLE ATMOSPHERIC CONDITIONS

Year and Receptor Location	Pollutant and Atmospheric Conditions									
	Particulate (ug/m^3)		SO_2 (ppm)		CO (ppm)		Hydrocarbons (ppm as CH_4)		NO_2 (ppm)	
	U	S	U	S	U	S	U	S	U	S
1972										
Downwind Boundary	17.76	56.64	T	0.003	0.56	1.78	0.22	0.69	0.005	0.021
1 Km. Downwind	3.85	12.25	T	T	T	T	0.03	0.17	T	T
2 Km. Downwind	1.64	6.43	T	T	T	T	T	0.03	T	T
1985										
Downwind Boundary	252.66	402.78	0.010	0.031	2.48	7.92	1.05	3.33	0.055	0.177
1 Km. Downwind	54.63	87.09	T	T	T	T	0.23	0.36	T	T
2 Km. Downwind	23.21	45.76	T	T	T	T	0.10	0.12	T	T
3 Km. Downwind	6.71	30.06	T	T	T	T	0.06	T	T	T
1995										
Downwind Boundary	384.05	612.19	0.016	0.051	3.69	11.79	1.69	5.38	0.088	0.280
1 Km. Downwind	82.98	132.37	T	0.025	T	2.55	0.36	0.58	T	0.030
2 Km. Downwind	35.32	69.55	T	T	T	T	0.15	0.20	T	T
3 Km. Downwind	10.08	45.68	T	T	T	T	0.09	0.10	T	T

Note: Figures indicate air pollutant levels at various receptors as projected by a hybrid air pollution model under stable and unstable atmospheric conditions.

U = Unstable. S = Stable. T = Trace.

Impact Assessment Reports", dated July 1974. This methodology assumes a "closed box" situation. The "box" is longitudinally centered on the runway with a width of 1,600 meters (5,250 feet), a height of 1,100 meters (3,600 feet), and a variable length dependent on the type of aircraft under consideration. This is a valid assumption in that it would take less horizontal distance for high performance aircraft to reach a given altitude than an aircraft of lower performance. Similarly, the volume (cubic meters) of air that the emissions disperse in increases in proportion to the length of the box.

LTO emissions are assessed according to the number of aircraft and the aircraft population mix occurring during peak hour conditions. A peak hour is that condition in which the greatest number of aircraft operations occur during any hour of the operating day; therefore, it is a measure of the worst emission conditions expected to occur at the Airport.

Peak hour aircraft operations were determined for the year 1972 and forecast for the years 1985 and 1995. This information was used with the methodology described above to determine projected aircraft emissions during peak hour conditions. Results of this determination are presented in Table 12.

It is important to note that both modeling techniques presented in this report reflect emission conditions occurring at the Airport by aircraft. To interpret accurately the effect an airport has on an area's air quality, the aircraft emissions should be added to the ambient air quality conditions. It should be realized that the best available data for ambient conditions are those samples collected in the City of Santa Rosa, 7 miles southeast of the Airport (Table 9).

As already pointed out, air pollution models provide only estimates and there is room for error around the calculated values. Furthermore, the models do not assume any technological advances which might reduce air pollution by 1985 or 1995.

Table 12

PROJECTED PEAK HOUR AIRCRAFT AIR POLLUTANT EMISSIONS
Sonoma County Airport

Aircraft Type	POLLUTANT EMISSIONS (ug/m^3) Particulates	Sulfur Oxides	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides	Total Emissions
1972						
Single-engine Piston	.0052	.0026	2.6	.1040	.0130	2.7248
Light-twin Piston	.0018	.0009	.9	.0315	.0040	.9382
Heavy-twin Piston	.0045	.0025	2.5	.3425	.0035	2.8530
Turbo-Prop	.0012	.0010	.1	.0063	.0067	.1152
Turbo-Fan	.0020	.0063	.3	.0577	.0265	.3925
Total 1972:	.0147	.0133	6.4	.5420	.0537	7.0237
1985						
Single-engine Piston	.0147	.0073	7.3	.2940	.0367	7.6527
Light-twin Piston	.0050	.0025	2.5	.0875	.0113	2.6063
Heavy-twin Piston	.0180	.0100	10.0	1.3700	.0140	11.4120
Turbo-Prop	.0050	.0040	.1	.0250	.0270	.1610
Turbo-Fan	.0080	.0250	1.0	.2310	.1060	1.3700
Total 1985:	.0507	.0488	20.9	2.0075	.1950	23.2020
1995						
Single-engine Piston	.0221	.0110	11.0	.4420	.0552	11.5303
Light-twin Piston	.0076	.0038	3.8	.1330	.0171	3.9615
Heavy-twin Piston	.0225	.0125	12.5	1.7125	.0175	14.2650
Turbo-Prop	.0075	.0060	.1	.0375	.0405	.1915
Turbo-Fan	.0120	.0375	1.5	.3465	.1590	2.0550
Total 1995:	.0717	.0708	28.9	2.6715	.2893	32.0033

Relocation of Persons

Under the recommended acquisition program for the airport development, 75 residences north of the Airport and 7 residences south of the Airport may be acquired. The estimated average tax assessed value of these houses is approximately $15,000. The Department of Housing and Urban Development has ascertained that adequate comparable housing is available. There are no businesses, schools, hospitals, etc., that fall within the proposed acquisition area.

Any relocations that result from land acquisition will be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 where the sponsor agrees that (a) fair and reasonable relocation payments and assistance shall be provided to or for displaced persons; (b) relocation assistance programs shall be provided displaced persons; and (c) within a reasonable period of time prior to displacement, decent, safe, and sanitary dwellings will be available to the displaced persons.

Flora and Fauna

The environmental setting portion of this report describes the biological communities on and around the Airport. The proposed development program, including the extension of Runway 14-32, involves the paving of approximately 13 acres of grassland. This grassland is a successional one and the species composition is apparently similar to other disturbed grassland sites. This impact is not considered particularly significant, though it represents a loss of some habitat. On the other hand, the land acquisition program will acquire land which might otherwise be developed. Therefore, since the areas to be acquired are to be used to eliminate incompatible land use, there will be at least a constant, if not an increase in the available wildlife habitat.

The most significant impact would accompany the runway extension to Runway 14-32. If 500 feet were added to either end, it would require considerable fill in the area north of the Airport which is now a wet grassland, some elimination of grassland at the south end, the probable elimination of a small man-made reservoir south of the runway, and some cutting of trees along Mark West Creek. If the extension were just to the north (1,000 feet) then no impact would occur south of the Airport, but a very large amount of fill material would be required to raise the end of the runway approximately 17 feet at the north end. If the extension were to the south, the reservoir would be eliminated, the aircraft activity would be nearer a private game refuge just south of Laughlin Road, and habitat alteration would occur along Mark West Creek.

The height of numerous trees along 1,700 feet of Mark West Creek, which lie in the approach surface for Runway 32R, would have to be lowered. In the past, trees within this area have been continually trimmed to provide aircraft approach protection to Runway 32. The 1,000-foot extension would require more extensive trimming of the trees within the southerly approach. In some areas of this 1,700-foot section of Mark West Creek, trees would have to be completely removed, whereas in others, heights as great as 30 feet above the runway end would be permissible. The allowable height of individual trees in this area will be a function of their distance from the proposed runway end. Whenever the vegetation along a stream bank is removed, there are several consequences including loss of riparian vegetation and habitat, increased potential for erosion and sedimentation, increase in water temperature and change in stream flora and fauna, and a decrease in aesthetic value of the stream. All of these adverse effects would accompany any significant cutting along Mark West Creek.

Water Pollution and Waste Disposal

The paving of an additional 13 acres of property on the Airport will increase runoff during heavy rains, but the Airport is well-drained. The average rainfall is 30 inches, so on 13 acres there would be 32.5 acre-feet of water or 10.6 million gallons per year. If the 13 acres were not paved, some water would still be runoff based on the average slope and soil permeability of 0.63 to 2.00 inches per hour. Therefore, the 32.5 acre-feet is the maximum possible increased runoff and assumes there would be no runoff without the project. This increased runoff is not expected to have any particular effect.

Pollution of the surface water resources could presumably occur during the construction phases of the project. Erosion, especially during construction, will be a problem which should be considered. Since this report preceeds the actual description of the construction process, it is impossible to identify specific danger points. However, the procedures outlined in the Federal Aviation Administration's Advisory Circular 150/5370-7, April 1971, should be rigorously followed by all contractors.

A second major source of water pollution is from inadequate sewage and sanitation systems as well as solid waste disposal in landfills. At the present time the sewage system serving the Airport is adequate. The capacity of the plant is approximately 80,000 gallons per day and it is operated at an average daily level equal to 15% of capacity. It is estimated that the Airport presently generates 2,000 to 3,000 gallons of sewage per day. The existing procedure for solid waste disposal is for truck removal to a landfill. In 1973, the average solid waste produced was about 23 cubic yards per week. It is anticipated that this amount will increase more or less proportionately with increased activity at the Airport. Disposal areas for this waste should be constructed so as not to contaminate either ground water or surface runoff.

Finally, a major source of potential water pollution at the Airport arises from aircraft maintenance and around aircraft parking aprons. The major problems arise from spillage of fuel or oil and from the residue from aircraft in the washracks. Up to the present time, no major problems appear to have arisen. However, there are no oil separators at the Airport presently, and surface drainage is either into the sewer system or into the creeks north and south of the Airport. Aircraft operators are prohibited from dumping oil and several drums have been placed about the hangar area to collect waste oil. As activity at the Airport increases, more effort will be required to improve the oil and fuel disposal system.

Disruption of Communities

The project will not disrupt any communities, but there will be some increased travel time for a few families since Laughlin Road would eventually be closed or relocated if Runway 14-32 were extended to the south.

Aesthetic and Visual Impacts

During the construction and operational phases, there will be some adverse visual and aesthetic effects. If a 1,000-foot southern extension of Runway 14-32 occurs, the visual effects will be particularly noticeable since numerous trees will be lowered or eliminated along Mark West Creek in order to protect the approach to Runway 32. This means that some forest vegetation will be replaced by a cleared area. In addition, Laughlin Road will be closed or relocated, which will require some renovation work. The ultimate plan also calls for considerable building area expansion on airport property east of existing Runway 14-32. This would include expansion of FBO areas, increased aircraft parking areas, and additional aircraft storage buildings. During the construction of these facilities, as well as the general aviation runway and accompanying taxiways, there will be a local adverse visual effect.

Recreational and Natural Areas

There are no recognized recreational areas near the Airport which would be affected by the proposed action, though there is a private game preserve south of the Airport which would be disturbed as a result of the extension of Runway 14-32 to the south.

Public Lands

There are no public lands involved in any of the proposed projects.

Rare and Endangered Species

There are recognized rare and endangered species which have been reported from near or on the Airport -- the bald eagle, golden eagle, and peregrine falcon. However, there is no apparent reason to believe the Airport constitutes a unique habitat, nor to believe the project would have any particular impact on these species.

Historical and Archeological Sites

A survey of Sonoma County has uncovered more than 100 buildings, bridges, etc., that are of some historical significance, while the North Coast Archeological Group from Sonoma State College has mapped over 500 known sites of archeological significance. Of these numerous sites, however, there exist only five of local significance in the vicinity of Sonoma County Airport and the City of Santa Rosa, and none of these will be affected by the proposed action. These sites are:

- A unique stone and mortar bridge, one of the few in the area, located in the Windsor area off of Slusser and River Roads.

- A wooden barn situated off of Eastside Road, south of River Riad. Its setting is unique -- in a small hollow between wooded hills.

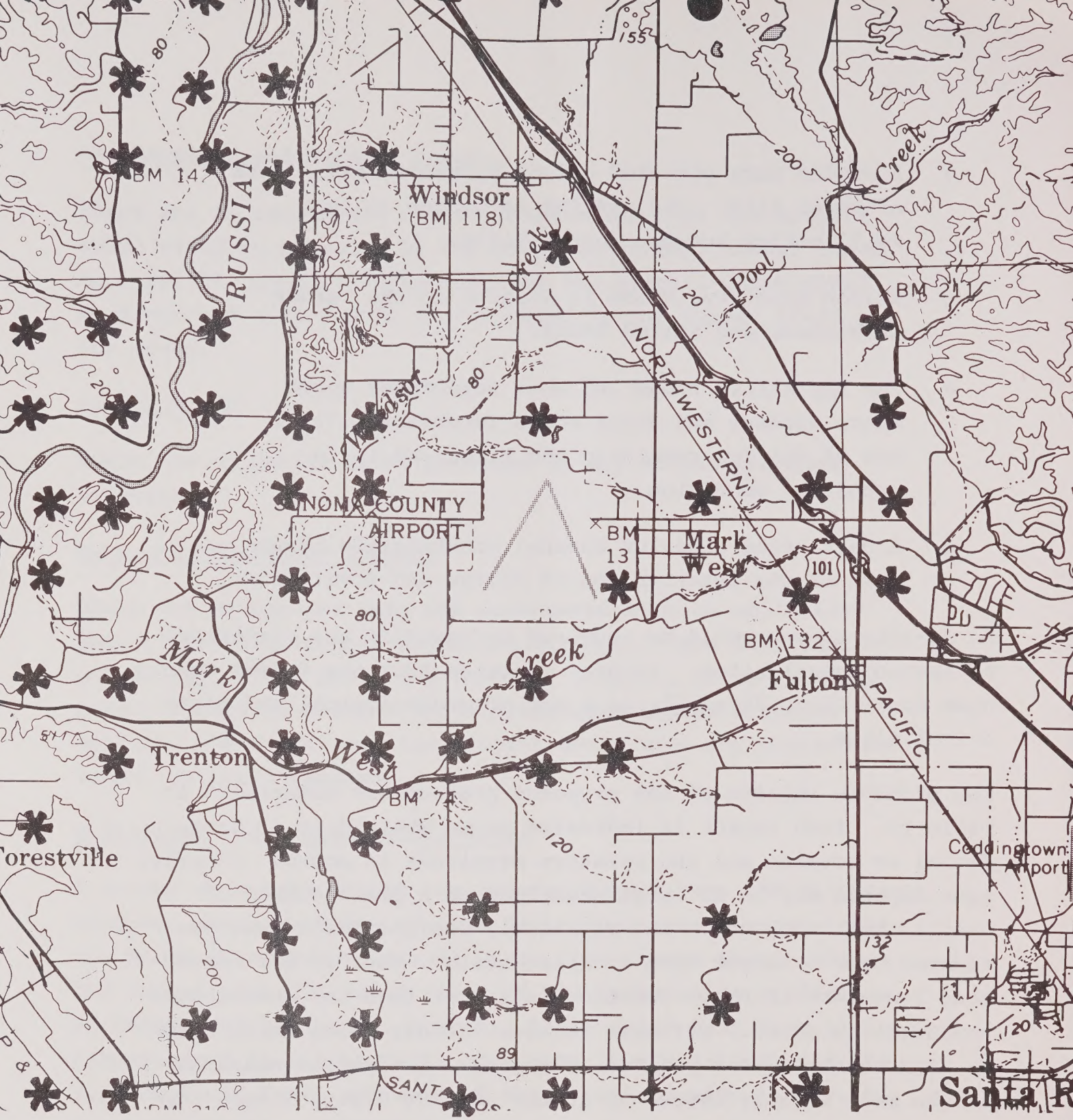
- Shiloh Cemetery, which is located at the corner of Windsor and Shiloh Roads.

- The hop kilns, stone and wood structures north where Slusser and River Roads intersect. It is one of the few remaining hop kilns and is in excellent condition.

- A dark stone fence of unusual construction southeast of the intersection of Fulton and River Roads.

An on-site survey would be required to identify any historical or archeological sites. Figure 8, taken from the Sonoma County Open Space Plan, Phase II, is a map of archeological and historical sites.

The probable impacts of the proposed project are summarized in Table 13. Each impact is indicated as to whether it is beneficial or adverse and the relative magnitude is noted. Clearly, some impacts may be of large magnitude to a small number of people, habitats, etc., but relatively insignificant when considered over a larger time or space scale. Impacts are considered long-term if their duration is longer than the anticipated construction phase. Off-site impacts include those which occur on land which has not yet been acquired. Mitigation measures can be more clearly suggested at the project design stage. Impacts are considered cumulative when they augment other impacts caused by the project or other processes occurring in the project vicinity, for example, increased urbanization.



ARCHEOLOGICAL SITES

● KNOWN SITE

* HIGH PROBABILITY OF SITE

1/4 Mi. 1/2 Mi.

FIGURE 8

SUMMARY OF PROBABLE IMPACTS OF PROPOSED ACTIONS (GENERAL AVIATION RUNWAY, LAND ACQUISITION, . AND RUNWAY EXTENSIONS) Sonoma County Airport

ENVIRONMENTAL CHARACTERISTIC	BENEFICIAL, ADVERSE, OR INDETERMINATE	MAGNITUDE OF IMPACT	SHORT- OR LONG-TERM	OFF-SITE	MITIGATION MEASURES	CUMULATIVE OR NOT
Climate	No effect.	--	--	--	--	--
Geology	No effect on parent material, but adverse change in topography with runway extension.	Small	Long-term	On-site		Not cumulative
Soils	Possible adverse effects in terms of erosion and decrease in infiltration with increased paving.	Small effect on run-off, potentially significant for erosion with runway extension.	Short-term	On- and Off-site	Techniques to reduce erosion (mulch/seeding/ minimize exposed land/ construct in dry season)	Not cumulative for erosion, cumulative for increased runoff
Ground Water	None	--	--	--	--	--
Surface Water	Contamination from airport activies, i.e., maintenance, fuel and oil spills, etc. Altered drainage with north runway extension.	Potentially significant as aircraft activities increase. Relatively small effect on drainage.	Long-term	On- and Off-site	Separate drainage system/ fuel spill washing techniques/oil separators. Culverts or drainage ditch north of Airport.	Not cumulative in normal sense, but if these were a major problem, potential toxic materials could build up in food chain.
Noise	Adverse effect from construction and aircraft activity.	Not particularly significant, especially with land acquisition, although will be effect on neighboring homes.	Short-term from construction; long-term from aircraft activity.	On- and Off-site	Land acquisition will minimize effect on surrounding community; employment of noise abatement procedures.	Construction not cumulative; operational noise not cumulative at predicted levels.
Flora	Adverse effect on vegetation with runway extension; beneficial with land acquisition.	Potentially significant if involves Mark West Creek.	Long-term	On- and Off-site	Elevating runway to minimize impact on Mark West Creek; extending to the north.	Cumulative only if involves Mark West Creek and there are other encroachments on the stream.
Fauna	Adverse on habitat and wildlife if involves Mark West Creek. Land acquisition would preserve some habitat.	Potentially significant if involves Mark West Creek.		On- and Off-site	Same as for Flora.	Same as for Flora.
Agriculture	Essentially no effect, except land acquisition might limit land use and runway extension would impact a small orchard	Small	Long-term	Off-site	None	Cumulative
Archaeological/ Historical	None known.	--	--	--	--	--
Natural Areas/Parks Game Preserves/etc.	Runway extension to south would impact private game preserve.	Large on private game preserve.	Long-term	Off-site	None	Cumulative
Existing Transportation System	Southern extension would require relocation of Laughlin Road	Moderate.	Long-term for increased driving distance; short-term for construction inconvenience.	Off-site	Construction of road in another location.	Not cumulative.
Disruption of Communities	None	--	--	--	--	--
Socioeconomic	Land acquisition would require relocation of families.	Great on individuals involved.	Short-term.	Off-site	Assurance that adequate housing exists and fair compensation for land values	Not cumulative.

ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

As discussed in previous sections, the adverse effects of the projects include the disruption which will accompany construction, particularly visual effects; air pollution; and potential water pollution. There will be increased runoff of surface water with the potential for increased pollution as aircraft activity increases. Approximately 13 acres of concrete will replace native vegetation.

There will be a disruption of traffic since Laughlin Road will eventually be closed with the southern extension to Runway 14-32. As aircraft and vehicular activity increases, partly in response to the project, there will be an increase in air pollution and noise. As the land acquisition program is completed, private control will be lost on 575 acres of land and 44 houses may ultimately be removed, necessitating the relocation of those residents.

The adverse effects of the project have been summarized in Table 13. This table and various sections of the text outline possible mitigation measures.

PROJECT ALTERNATIVES

Alternative Transportation Modes

The residents of Santa Rosa and Sonoma County are afforded three major modes of transportation -- automobile, bus, and aircraft. Automobile users have good north-south transit via U.S. Highway 101. There is a relatively high frequency of scheduled bus service from Santa Rosa. Grayhound Bus Lines has four daily buses to San Francisco, one to Napa, and five northbound. Additionally, Golden Gate Transit (a commuter shuttle bus line) has 56 daily southbound buses to San Francisco, 41 of which run during the morning commute period. During weekends and holidays, service

is reduced to 26 southbound buses to San Francisco. There is no passenger rail service in the County and the closest stations are Oakland and Davis.

Air travel, both private and commercial, is and will continue to be an integral part of the area's overall transportation network because of the speed and versatility provided its users. It is for this reason that a Master Plan for Sonoma County Airport was developed. Two very general options available for the disposition of Sonoma County Airport are that it continue as a public-use aviation facility or that it be closed and aviation demand be accommodated elsewhere.

The effect of reallocating Sonoma County Airport activity to other existing airports was studied. The closest alternative commercial service is available at San Francisco International and Oakland International airports. They are both approximately 90 minutes driving time from Santa Rosa and offer high-frequency air carrier service. The nearest general aviation alternative is Santa Rosa Air Center whose continued availability as a public-use airport is uncertain. Additionally, the reallocation of Sonoma County Airport traffic to Santa Rosa Air Center would exceed the operational capacity of the latter. It is the conclusion of this study that only a portion of the aviation demand at the County Airport could be met elsewhere and even that portion would suffer cost and convenience penalties. There would be significant negative social and economic impacts associated with the selection of this option. The second option of continuing the present function of the Airport requires that consideration be given to the future development of the facility.

Development Alternatives

Alternatives for the development of Sonoma County Airport fall under three general categories: those associated with the parallel

general aviation runway, those associated with the extension to Runway 14-32, and those associated with the purchase of land in both approach zones to the main runway. The environmental impacts for each category of alternatives were studied separately and the conclusions are outlined below.

Parallel Runway Alternatives: Six alternatives were studied with respect to the construction of a parallel runway. The first, or null alternative limits the operational capacity of Sonoma County Airport to its present level of 275,000 annual operations. When capacity is reached, circa 1980, users will either decide to operate from another airfield, discontinue flying, or continue to operate at Sonoma County Airport with delay penalties. Positive environmental impacts for this alternative include the limiting of total airport activity and the elimination of adverse impacts associated with the construction process.

The construction of an airport in the Santa Rosa area which would afford approximately the same additional capacity as a parallel runway would require a minimum of 80 acres of property along with the required aviation support facilities. This would involve substantial duplication, since property and support facilities capable of accommodating a parallel runway presently exist at Sonoma County Airport. If no relief is provided, delays of 10 to 15 minutes may be realized during times when demand substantially exceeds capacity. Since these delays are very costly in terms of time and fuel wasted, an airport operating at levels above its capacity would not be very attractive to businesses that rely on aviation services.

The remaining five alternatives in this category involve the construction of a 3,200-foot general aviation runway parallel to, and 700 feet to 1,400 feet southwest of, existing Runway 14-32. Such a runway would increase the operational capacity of Sonoma

County Airport by approximately 35% (275,000 to 370,000 annual operations). This runway would be used to accommodate a large percentage of the Airport's training operations, thus increasing the efficient utilization of the main runway by transient operations, larger aircraft, and aircraft making practice instrument approaches.

Associated with this project was the construction of an exit taxiway for Runway 1-19. This exit would be so located to accommodate approximately 75% of the aircraft landing on Runway 1, thus decreasing the "taxi to terminal area" distance by over one mile. This will result in added convenience to airport users and a decrease in total aircraft-related emissions. As mentioned, five sub-alternatives were considered for the location of the parallel runway and exit taxiways; however, it was concluded that the environmental differences between sub-alternatives were insignificant.

Runway Extension Alternatives: Five alternatives relating to runway extension at Sonoma County Airport were evaluated: (1) no extension, (2) 1,000-foot extension of Runway 14-32 to the north, (3) 1,000-foot extension of Runway 14-32 to the south, (4) 500-foot extension of Runway 14-32 to the north and 500-foot extension to the south, and (5) 1,000-foot extension of Runway 1-19 to the south.

The first, or null alternative, is perhaps the optimum from a purely environmental standpoint. This alternative precludes use of the Airport by larger, potentially noisier aircraft. Additionally, none of the adverse environmental impacts associated with the construction phase of an extension project would be experienced. The existing 5,000-foot runway is capable of safely accommodating a majority of the aircraft demand which can be expected through the forecast period.

There will, however, be times when aircraft will not be able to depart from a 5,000-foot runway (14-32) because of combinations of high aircraft weight and air temperature. This will require either a payload/range reduction or a delay until temperatures decline. Either of these options will result in economic and convenience penalties to airport users, particularly those associated with the aerial fire fighting effort at Sonoma County Airport. Also, the limiting of the runway length to its present length would have an adverse effect upon future service by scheduled air carriers using conventional aircraft. This would be particularly true in the Sonoma County-Los Angeles market if the community should ever petition to receive direct service in this market.

The three construction alternatives with regard to Runway 14-32 have several common effects which were studied and compared to the null alternative. All three will provide 6,000 feet of runway length which, with only minimal payload/range restrictions, will accommodate future potential runway length requirements. All three alternatives have the additional advantage of increasing operational and safety margins for aircraft presently using the Airport. There are distinct environmental differences between Alternatives 2 through 4 which were evaluated and are outlined herein.

A 1,000-foot extension to the north end of Runway 14-32 would require an estimated 400,000 to 500,000 cubic yards of fill to meet horizontal and longitudinal runway grade requirements. In addition to the 1,000-foot air carrier taxiway and holding apron common to Alternatives 2 through 4, an additional 400 to 500 feet of taxiway would be required at the north end to improve the existing angled access. The adverse environmental impacts associated with substantial fill and paving would therefore be greater for a northerly extension than for Alternatives 3 or 4.

The density of residential development to the north is greater than to the south. Moving the runway threshold 1,000 feet would lower the flight path of aircraft landing on Runway 14 and increase the noise impact of aircraft over the north approach, implying an adverse impact to a greater number of homes.

An extension to the south of Runway 14-32 (Alternative 3) would require approximately 100,000 cubic yards of fill, 20% to 25% of that required for Alternative 2. Construction to the south would require crossing an existing waterline and necessitate either the relocation or closure of Laughlin Road. The precise impacts associated with these measures will require additional study and a determination of the exact procedures to be utilized; however, it appears that Laughlin Road could be replaced with comparable access and the crossing of a waterline is more of an economic cost than an environmental cost.

The major environmental disadvantage of this alternative is the adverse impact it would have upon Mark West Creek. A runway extension to the south would lower the FAR, Part 77 approach surface over Mark West Creek, requiring increased trimming of the trees following approximately 1,700 feet of the creek bed. The 1,000-foot southerly extension will have a positive impact upon residents north of the Airport because aircraft taking off on Runway 32 will be at a greater altitude when they pass over the area north of the Airport.

Splitting the runway extension (Alternative 4) would involve approximately 150,000 cubic yards of fill and the same considerations with respect to the waterline and Laughlin Road as a 1,000-foot southerly extension. There would be additional paving and construction required since new holding aprons would be required at each end of the runway. This alternative was considered as somewhat of an environmental compromise, as it would lower the approach

path over the residences to the north somewhat less than a northerly extension and require less tree trimming than the southerly extension.

Much additional study will be required to determine if Alternative 5, a 1,000-foot southerly extension to Runway 1-19 with all takeoffs to the south, is technically or operationally feasible. If this program were implemented, the effects upon both the human and natural environment would be minor. Departing aircraft would be flying over very sparsely populated areas and the extension itself would result in very little alteration of the natural environment.

Implementation of the recommendation (by the Association of Bay Area Governments and the State Airport Systems Study) for a North Bay air carrier airport in either Napa or Marin counties would probably rule out the need for a runway extension at Sonoma County Airport. At the printing of this report, no positive planning addressing this issue is underway.

Land Acquisition Alternatives: The alternatives with respect to land acquisition are essentially either to purchase the property within the approaches to the Airport or not to purchase the property. The human environment of those persons presently residing in these areas will be affected by either alternative. In the null case, residents will continue to be affected by airport noise. If the property is acquired, the residents will be affected by the resulting relocation process, although Federal law requires that comparable housing be made available and all relocation costs be paid for by the project sponsor. In the null case, the natural environment will most likely continue to be altered by scattered residential development as in the past. If the property is acquired, it will be maintained as open space with agricultural uses. This project will enhance the natural environment since the preservation of this open space will have a positive effect upon the wildlife of the area.

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The principal short-term effects of the development program at Sonoma County Airport will be those associated with the construction and relocation processes. To minimize any adverse effects of construction activities, the County will incorporate guidance material development under provisions of the Airport and Airway Development Act of 1970, as amended, and other appropriate specifications[1/] into the construction contract documents. The short-term uses essentially involve committing some present developed and undeveloped land to airport development.

There will also be short-term social disruption associated with the relocation of residential units in the approach areas to be acquired. Mitigation of this disruption will include adherence to all Federal, State, and local regulations pertaining to the relocation of households.

There will be long-term social, economic, and environmental benefits to the proposed development. The social benefits include accommodating a demonstrated demand for aviation facilities within Sonoma County, provision for improved aerial fire fighting equipment, and the enhanced safety and efficiency of aircraft operations. Economic benefits will be derived through a reduction in congestion and aircraft delay and the availability of facilities for businesses requiring access to the air transportation system. The proposed acquisition of land in both approach zones will insure the continued compatibility between the Airport and adjacent land uses. Families being displaced will be relocated to more favorable locations for residential development and existing agricultural uses will continue unabated.

1/ FAA, Advisory Circular 150/5370-1A, "Standard Specifications for Construction of Airports" and FAA, Advisory Circular 150/5370-7, "Airport Construction Controls to Prevent Air and Water Pollution".

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

There will be the commitment of building materials for the construction of runways and taxiways, as well as an irretrievable expenditure of energy required during the construction process.

For all practical purposes, 13 acres of grassland would be converted to pavement, although the pavement could be removed and the area restored to its present state if it were so desired.

Additionally, all of the time and labor that is expended in the planning, design, and construction of the proposed projects are irretrievable.

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Department of Health Services, Public Health Service

Sonoma County Sanitation Department

Bay Area Air Pollution Control District

Air Pollution Control District - Northern Sonoma County

City Parks and Recreation District

Bureau of Sport Fisheries

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